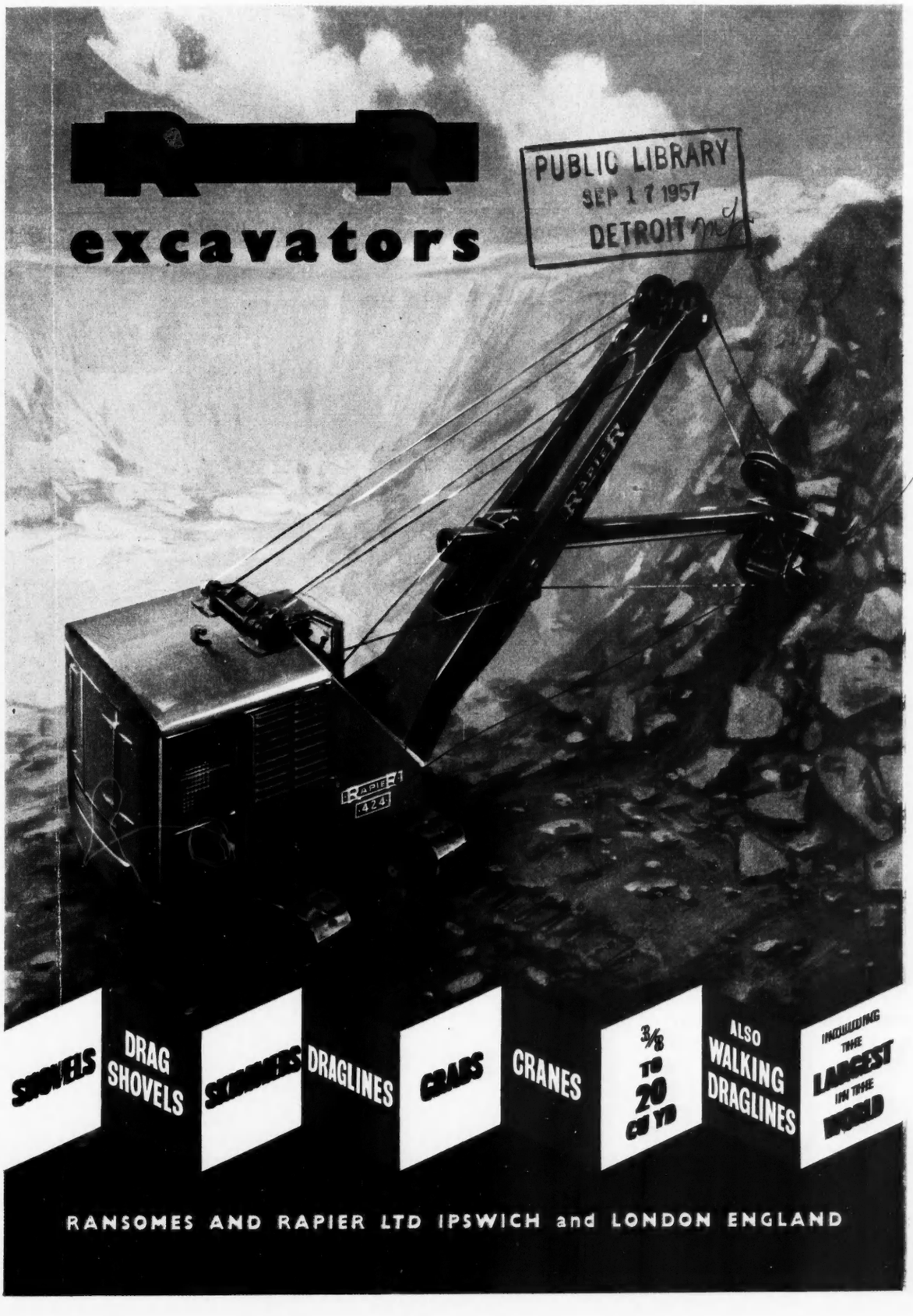
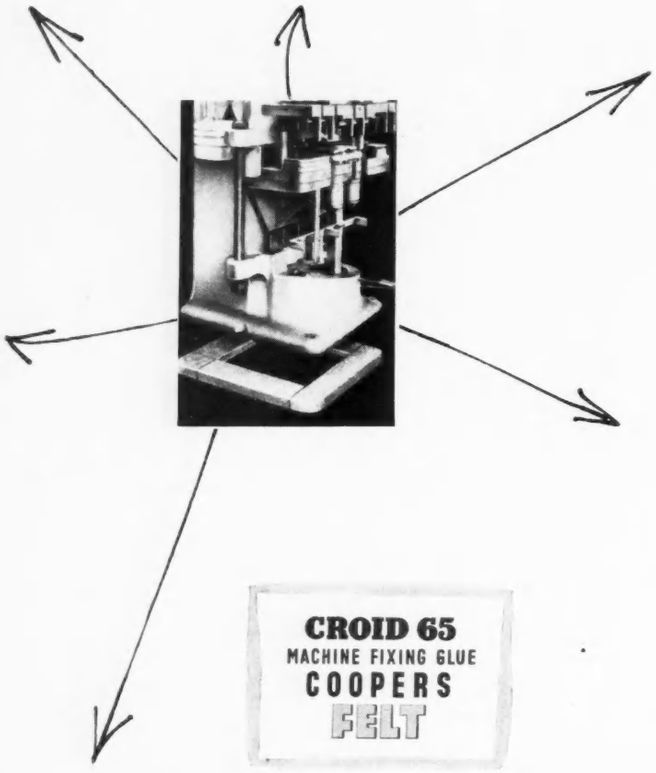
OLOGY DEPT.

# The Engineer

AUGUST 30, 1957 28 ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS




XUM

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Imagine your machines stuck down on a felt ba which can absorb over 80% of vertical vibration, which has a holding power of 50 lb. to the square inch, which does away with bolts, grouting, damaged floors. Then imagine deciding to chan your layout when the workers have left one evening and having all the machines ready for acti again in the morning. That's what Croid-Coop can do for you. Send for details to-day.

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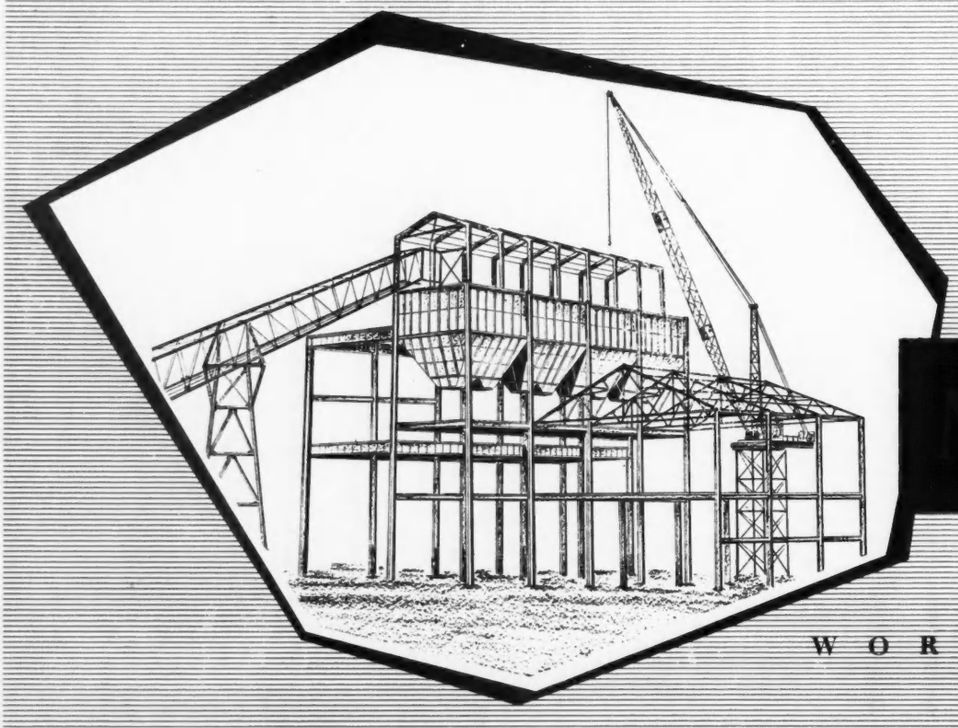
*Structural Engineers*



WORCESTER

# New Wickman Econotips cut tooling costs

The 'throwaway' tip principle already well-known and proved in industry can save 30% of your present carbide tooling costs. Clamped in a high-carbon steel holder by a quick-release screw, the Wimet tip can be quickly re-located to provide a brand new cutting edge without removing the tool from the machine.

*Saves Reservicing Time and Equipment*

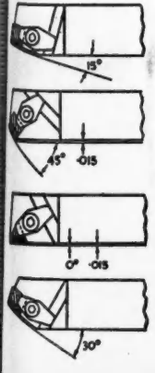
**No grinding ; when all the edges have been used, simply discard the tip and fit a new one.**

*Saves Tool Setting Time*

**Leave the tool at its proper setting ; just change or re-locate the tip and save re-setting time.**

*Improves Tool Performance*

**Stress-free Econotips give better tool performance, longer tool life and greater reliability.**




The provision of a second carbide tip below the cutting tip prevents shank wear from swarf abrasion, and also acts as an anvil support. Four styles are available ; with square tips to provide approach angles of 15°, 30°, and 45°, and with triangular tips providing a zero approach angle.

*Available in two Wimet grades*

**Grade N for machining cast iron and non-ferrous materials, and grade XL 2 for machining steels at high speeds.**

*An explanatory leaflet, giving further details of design and prices can be obtained on request from*

*Publicity Dept., Wickman Limited, Banner Lane, Coventry*

WICKMAN LIMITED

WIMET DIVISION, TORRINGTON AVENUE, COVENTRY

484 ST



# THE ENGINEER

*ESTABLISHED* 1856

28 ESSEX STREET, STRAND, LONDON, W.C.2.

Telephone : CENtral 6565

Vol. 204 No. 5301

**AUGUST 30, 1957**

Published every Friday Registered as a Newspaper


## PRINCIPAL CONTENTS

(Complete contents on page 289)


Low's Carthorse Speaks.....289

Technology and Wisdom.....290

L.C.C.'s New Town.....291

Performance and Efficiency Tests on B.R. Class "8" Locomotive—No. II .....292
(O. S. NOCK)

Engineering and Marine Exhibition.....305

Defensive Homing Missile.....295

Design of Foundations of Shell Building, London.....298
(G. M. J. WILLIAMS)

Radial Flow Machinery .....296

U. S. Army Package Power Reactor in Virginia—No. II .....327



**NOTICE TO READERS**

All letters intended for insertion in "The Engineer" or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

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**DISPLAY ADVERTISEMENT RATES—on request from The Manager.**

Published by
MORGAN BROTHERS (PUBLISHERS) LTD.,
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**INDEX TO ADVERTISERS ..... PAGE 135**

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CATALOGUES, when ready (price 6d.), from the Auctioneers :
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E8081

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PUBLIC APPOINTMENTS

### CARMARTHENSHIRE EDUCATION COMMITTEE

LLANELLY TECHNICAL COLLEGE

FULL-TIME ASSISTANT MASTER IN ENGINEERING

Applications are invited for the post of FULL-TIME ASSISTANT MASTER IN ENGINEERING at the above-named College.
Candidates should be Graduates in Engineering, or be Corporate Members of the Institution of Mechanical or Production Engineers, with industrial experience, and preferably some teaching experience in a technical college.
Salary in accordance with the Burnham Further Education Report, 1956 (£650 by £25 to £1025), for Grade B Assistants, including allowances for teaching and approved industrial experience.
Duties to commence on 1st January, 1958.
Further particulars and forms of application, which must be returned within two weeks of the appearance of this advertisement, may be obtained from the undersigned on receipt of a stamped addressed envelope.

IORWERTH HOWELLS,
Director of Education.
County Education Offices,
County Hall,
Carmarthen. E8129

### UNIVERSITY OF BRISTOL

DEPARTMENT OF PHYSICS

RESEARCH ASSISTANT

A RESEARCH ASSISTANT is wanted in the Department of Physics for experiments connected with the fatigue of metals. The appointment is a temporary one and will be in the first instance for two years, with the possibility of further extension. Candidates should have qualifications in engineering, physics or metallurgy (in that order of preference), and should preferably have had some research experience. Salary in the region of £600–£700 p.a., according to qualifications and experience.—Applications, giving details of such qualifications and experience, should be sent to the Registrar, University of Bristol, as soon as possible. E8114

### STAFFORDSHIRE POTTERIES WATER BOARD

GREATGATE PUMPING STATION

APPOINTMENT OF FOREMAN

Applications are invited for the above appointment from suitable candidates not exceeding 45 years of age, who must have received a sound engineering training with subsequent experience on diesel engines and electrical pumping plant.
The salary will be Grade IV (£502 5s. to £589 7s. 6d. p.a.), subject to the Scheme of Conditions of Service for Miscellaneous Classes of Officers. In addition to the salary a modern house is available rent and rates free.
Applications, in the candidates' own handwriting, stating age, whether married, full details of apprenticeship, past and present positions, with dates, description of duties carried out, together with copies of two recent testimonials, must be delivered to the undersigned not later than Saturday, 14th September, 1957.
The post is on the permanent establishment and will be subject to the Local Government Superannuation Acts, 1937 and 1954, and to the selected candidate passing a medical examination.

C. V. BROWN, M.I.C.E., M.I.Mech.E., M.I.W.E.
Engineer and Manager.
Albion Street, Hanley, Stoke-on-Trent. E8160

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**Copy Date.** "Run-on" and "Semi-Displayed"—by noon on Tuesday for publication on Friday of the same week.
"Displayed" and "Illustrated"—by noon on Friday for publication on the following Friday.

*For styles and sizes of "Run-on", "Semi-Displayed", "Displayed" and "Illustrated" Classified Advertisements please send for Circular.*

***Advertisements for publication should be addressed to:—***
**Classified Advertisement Dept.,**
**"The Engineer", 28 Essex Street, Strand, London, W.C.2.**
***Urgent advertisements may be telephoned to CENtral 6565.***

E. R.

*By Order of the Minister of Supply*

## GOVERNMENT SURPLUS STORES

TO BE SOLD BY AUCTION

AUCTION PROGRAMME

| | | Main Location of Stores | Auctioneers |
|---|---|---|---|
| September 4 | Miscellaneous stores, including furniture, kitchen utensils, barrows, bicycle spares, canvas | General Stores Sub-Depot, Longtown, Nr. Carlisle | HARRISON & HETHERINGTON LTD. (Dept. L), Botchergate, Carlisle. (Tel. 26292/3.) |
| September 3–6 | Vehicles, lifting and earth moving equipment | M.O.S. Storage Depot, Ruddington, Notts | WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel. 47271.) |
| September 10–13 | Vehicles, machine tools and miscellaneous stores | M.O.S. Storage Depot, Royal Arsenal, Woolwich, London, S.E.18 | FULLER, HORSEY SONS & CASSELL (Dept. L), 10, Lloyd's Avenue, London, E.C.3. (Tel. Royal 4861.) |
| September 17–18 | *Miscellaneous stores, including large quantity of motor tyres | M.O.S. Storage Depot, Rotherwas, Hereford | RUSSELL, BALDWIN & BRIGHT LTD. (Dept. L), 20, King Street, Hereford. (Tel. 4366.) |
| September 20 | Miscellaneous stores, including furniture, blanket pieces, tools, rope, &c. | Command Ordnance Depot, Coypool, March Mills, Plymouth | WOOLLAND, SON & MANICO (Dept. L), Kinterbury House, St. Andrews Cross, Plymouth. (Tel. 65356.) |

* Diesel generating sets, large quantity of motor tyres and inner tubes, wireless sets, radio and electrical equipment, electric cable and wire, electric and blower motors, electric lamps, mercury glass filled elements, oil units, theodolites, periscopes and telescopes, stone crusher and concrete mixers, signal satchels, ball and roller bearings, transformers and compressors, M/T spares and equipment, including large number of engines and sparking plugs, pneumatic picks, riveters and saws, &c.

CATALOGUES (6d. each—P.O.s only), available from the Auctioneers shown above. E975

## PUBLIC APPOINTMENTS

### PUBLIC SERVICE OF SOUTH AUSTRALIA

#### HARBORS BOARD DEPARTMENT

#### CHIEF ENGINEER

Applications for the undermentioned position should be made in writing to the Agent-General for South Australia, South Australia House, Marble Arch, London, W.1, setting out full names, address, date of birth, marital status, academic qualifications, practical experience, and particulars of war service (if any). Copies of testimonials and photograph should be submitted with the application. Closing date 14th October, 1957.

CHIEF ENGINEER, Harbors Board Department (re-advertised).

Salary £3053 per annum.

Applications are invited for the position of Chief Engineer of the South Australian Harbors Board, a State Ports Authority charged with the administration, development and maintenance of the deep sea ports of Adelaide, Birie, Wallaroo, Lincoln and Thevenard, and also 50 minor outports.

Qualifications : applicants should be holders of approved University Degrees in Engineering or Corporate Members of the Institution of Civil Engineers, London, or Institution of Engineers, Australia, who have specialised in port and harbour engineering.

Duties : the Chief Engineer will be responsible for an engineering organisation at present numbering approximately 260 staff and 900 other employees, undertaking the design, construction and maintenance of engineering works and port installations. These include wharves and piers in reinforced concrete, steel and timber ; retaining walls in steel sheet piling and reinforced concrete ; piled foundations, steel-framed transity sheds and port buildings generally ; the mechanical equipment of wharves including electrically operated wharf cranes for general and heavy duty ; electric power and lighting ; major bulk coal and grain handling installations ; breakwaters and earthworks. He will also be responsible for a fairly large dockyard engineering establishment ; the maintenance and operation of a considerable fleet of dredgers, tugs, barges and other floating plant ; the execution of major dredging and reclamation works ; the installation and maintenance of aids to navigation ; and the use and upkeep of a wide range of construction plant.

Administrative capacity of a high order and ability to lead and co-ordinate the work of other qualified engineers are essential qualifications. The Chief Engineer is directly responsible to the General Manager, who is due to retire in March, 1961.
E8158

### MINISTRY OF TRANSPORT AND CIVIL AVIATION

#### CIVIL ENGINEERS

The Civil Service Commissioners invite applications for pensionable posts in London and certain large towns in the provinces.

Age, at least 25 and under 35 on 1st January, 1957, with extension for regular forces service and appropriate civil service. Candidates must have achieved Corporate Membership of the Institution of Civil Engineers or have passed or been exempted from Sections A and B (now sections I and II). They must have had experience in road and bridge construction and a knowledge of highways authorities' procedure is desirable.

London salary scale (men) £805 (at age 25) to £1250. (Somewhat lower in provinces.) Starting salary according to age up to £1085 at 35 or over. Prospects of promotion to higher grades on salary scales £1280 to £1720 and £1780 to £2050. Women's salaries lower but being raised to reach equality with men's by 1961.

Further particulars and application forms from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1., quoting No. S.64-65/57.

Interview Boards held at intervals, as required. Early application advised. E8083

### ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL

#### REACTOR ENGINEERING LABORATORY

#### HONOURS GRADUATES

Reactor Engineering Laboratory at Atomic Energy Research Establishment, Harwell, has vacancies for HONOURS GRADUATES to work in the following and related fields : Heat transfer and fluid mechanics ; special instrument and component development ; solid mechanics ; handling of unusual fluids ; physical property measurements.

Salary : £610–£1065 (Scientific Officer) ; £1155–£1355 (Senior Scientific Officer*).

* Research experience necessary.

Housing, superannuation and other excellent conditions.

Send post card by September 6th, 1957, to Recruitment (884Z/25), A.E.R.E., Harwell, Didcot, Berks., for application form and further details. E8082

### BRITISH RAILWAYS

#### WESTERN REGION

#### TECHNICAL ASSISTANTS

Applications are invited for vacancies for TECHNICAL ASSISTANTS experienced in designing and detailing steel bridges and structures in the steelwork office of the Civil Engineering Department at Paddington, salary range £809/£877.

Travel concessions, holidays with pay and permanency with membership of superannuation fund.

Applications stating age, previous experience, &c., to Chief Civil Engineer, B.R. Western Region, Paddington Station, London, W.2. E8084

### MINISTRY OF LABOUR AND NATIONAL SERVICE

#### H.M. INSPECTORS OF FACTORIES (CLASS II)

The Civil Service Commissioners invite applications from men and women for pensionable posts in the Factory Inspectorate which is being expanded. Age at least 21 and normally under 30 on 1st June in the year of application. Extension of the upper age limit for regular service in H.M. Forces and for candidates with exceptional qualifications. Starting salary : £545 (at age 21) up to £710 at 26 or over. Scale maximum £980. Somewhat lower outside London. A special increment of £25, within the scale, is granted after satisfactory probation. Higher posts filled by promotion from Class II. The salaries are now subject to an increase of the order of 5 per cent.

Duties include the enforcement of the provisions of the Factories Acts and Regulations affecting the safety, health and welfare of workpeople and extend to all manufacturing industries and to certain other places, including Docks, Works of Engineering Construction and Building Operations.

Candidates should normally have a University Degree (which may be in Science or in Arts subjects) or have technical qualifications of comparable standard (e.g., A.M.I.Mech.E.). Experience in works or other practical spheres is an advantage.

Candidates without Degrees or similar technical qualifications will be considered if they have had extensive works or other practical industrial experience (especially in responsible positions) and if they have good general or technical qualifications.

Application may be made at any time, and so long as there are vacancies suitable candidates will be interviewed.

Particulars from Secretary, Civil Service Commission, 6, Burlington Gardens, London, W.1, quoting No. 280. E8163

### CENTRAL ELECTRICITY AUTHORITY

#### EASTERN DIVISION

#### CIVIL AND STRUCTURAL DESIGNER DRAUGHTSMEN

Applications are invited for the following posts at Divisional Headquarters, Cockfosters, adjacent to Cockfosters Station (Piccadilly Line) :—

CIVIL AND STRUCTURAL DESIGNER DRAUGHTSMEN

Salary : N.J.B., Schedule " D," within the range of Grades 4/5, £800 by £20 to £945 per annum, including London Weighting.

The commencing salary will depend on experience and qualifications.

New offices recently completed in pleasant surroundings, excellent working conditions. Canteen available. Sports and social club. Sick pay and superannuation schemes. Generous holidays.

The candidates appointed will be required to undertake civil and structural design work, and applicants should have had experience in the design and detailing of reinforced concrete structures for heavy plant, culverts, &c., and structural steelwork as applied to industrial buildings.

Applications, stating age, qualifications and experience, should be sent to the Controller, Central Electricity Authority, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts.

W. N. C. CLINCH,
E974 Controller.

### THURROCK U.D.C.

#### ENGINEER AND SURVEYOR'S DEPARTMENT (SEWAGE DISPOSAL SECTION)

#### WORKING FOREMAN

Thurrock U.D.C. (Engineer and Surveyor's Dept. (Sewage Disposal Section) require WORKING FOREMAN. Applicants should be experienced in maintenance of sewage works and pumping stations, and control of labour, and must be competent Fitters and Turners. Knowledge of heavy oil engines advantageous. Salary : Misc. Grade VI, £620 2s. 6d.–£686 15s. per annum. Successful applicant required to live in bungalow, for which a rent of 6s. 6d. per week, exclusive of rates, will be charged. 7s. per week allowed in respect of electricity consumed. Appointment pensionable.

Applications, together with names and addresses of two referees, to Clerk of the Council, Council Offices, Grays, Essex, by 10th September, 1957. Canvassing disqualifies. Relationship with any member or Senior Officer of the Council must be disclosed. E8060

### AIR MINISTRY

#### WORKS DESIGNS BRANCH

#### DESIGNER DRAUGHTSMEN

Air Ministry, Works Designs Branch, requires in London, DESIGNER DRAUGHTSMEN for Bulk Petroleum Storage and Pumping Installations experienced in one or more of the following : (a) storage tank layout and design ; (b) pump house and plant layout ; (c) development of pipe line schemes ; (d) hydraulic calculations. Technical training to O.N.C. standard required. Salaries up to £1015 per annum. Starting pay dependent on age, qualifications and experience. Long-term possibilities with promotion and pensionable prospects. 5-day week. 3 weeks' 3 days' leave a year. Normally natural born British subjects.

Write, stating age, qualifications, employment details including type of work done, to any Employment Exchange, quoting Order No. Borough 605. E7944

### NEW ZEALAND MINISTRY OF WORKS

#### PROFESSIONAL AND TECHNICAL STAFF

The Ministry of Works, New Zealand, invites applications for the following vacancies on the permanent staff. Positions, qualifications desired and commencing salaries are as follows :—

CIVIL ENGINEERING DIVISION.

1. ENGINEERS.—Corporate Membership of the Institution of Civil Engineers, London. Commencing salaries from £895 to £1465 per annum.

2. ASSISTANT ENGINEERS.—A University Degree in Civil Engineering which gives exemption from Final Parts I and II of the A.M.I.C.E. examination or an equivalent examination. Commencing salaries from £810 to £1000 per annum.

3. ENGINEERING ASSISTANTS.—General Certificate of Education standard or equivalent and eight years' practical experience. Commencing salaries £810 to £1080 per annum.

4. DRAUGHTSMEN.—Ordinary or Higher National Certificate or equivalent and at least three years' experience at the drawing board. Commencing salary up to £1150 per annum in accordance with qualifications and experience.

MECHANICAL ENGINEERING DIVISION.

5. MECHANICAL & ELECTRICAL ENGINEERS.—Corporate Membership of the Institutions of Mechanical or Electrical Engineers, London, whichever is appropriate. Commencing salaries £895 to £1465 per annum.

6. BUILDING SERVICES ENGINEERS.—Corporate Membership of the Institution of Mechanical Engineers or of the Institution of Heating and Ventilating Engineers, London. Commencing salaries £895 to £1465 per annum.

7. ASSISTANT MECHANICAL, ELECTRICAL OR BUILDING SERVICES ENGINEERS.—A University Degree in Mechanical or Electrical Engineering or Graduate Membership of the above Institutions. Commencing salaries £810 to £1000 per annum.

8. MECHANICAL, ELECTRICAL OR BUILDING SERVICES DRAUGHTSMEN.—Ordinary or Higher National Certificate in Mechanical or Electrical Engineering or equivalent examination, and at least three years' experience in draughting, design and calculations. Commencing salaries £720 to £1000 per annum.

Inquiries, mentioning this paper and quoting reference No. 3/74/133, also stating the type and number of position sought, should be addressed to the High Commissioner for New Zealand, 415, Strand, London, W.C.2. Full details of duties, experience desired, and general information on the conditions of employment in the New Zealand Public Service, together with application forms, will then be furnished. E7820

### MANCHESTER CORPORATION WATERWORKS UNDERTAKING

#### APPOINTMENT OF ENGINEER AND MANAGER

Applications are invited for the position of ENGINEER and MANAGER of the Waterworks Undertaking from Civil Engineers having a wide practical experience of the design and construction of important civil engineering works for water supply, and experience of the management of a waterworks undertaking.

The commencing salary for the position will be £3170 per annum, rising to £4230 per annum, by annual increments of £130.

A form of application, together with an explanatory statement of the scope of the duties, may be had on written application to the Secretary, Waterworks Department, Town Hall, Manchester 2.

Completed applications must be received by me not later than 1st October, 1957.

PHILLIP B. DINGLE,
Town Hall, Manchester 2. Town Clerk.
E8086

### WOLVERHAMPTON CORPORATION

#### WATER UNDERTAKING

#### APPOINTMENTS

Applications are invited for the following two posts :—

(1) ASSISTANT ENGINEER, salary £814–£994 (A.P.T. V).

(2) ENGINEERING ASSISTANT, salary £727–£907 (A.P.T. IV).

Candidates should be A.M.I.C.E. with experience of boreholes, pumping stations and pipelines. Good experience to be had on new works. Houses to rent. N.J.C. service conditions, posts pensionable, medical examination.—Apply, naming two referees, to Water Engineer and Manager, 37, Merridale Road, Wolverhampton, by 9th September. E8119

### NATIONAL COAL BOARD

#### NORTH EASTERN DIVISION

#### TWO SHIFT CHARGE ENGINEERS

TWO SHIFT CHARGE ENGINEERS required at the Grimethorpe Generating Station (60MW) in the No. 4 (Carlton) Area. Salary £835 per annum (flat rate).

Applicants should have had experience in modern power station practice, with chain-grate stokers burning inferior fuel. Preference will be given to those persons possessing the Higher National Certificate (or equivalent) and being a Corporate Member of a recognised Institution.

Apply to No. 4 Area Staff Manager, Grimethorpe, Nr. Barnsley, by 13th September, 1957. E8155

### UNITED KINGDOM ATOMIC ENERGY AUTHORITY

#### RISLEY, WARRINGTON, LANCASHIRE

#### RESEARCH PLANNING OFFICERS

Vacancies exist with the Research and Development Branch of the Industrial Group of the United Kingdom Atomic Energy Authority at its Headquarters at Risley, Warrington, Lancashire.

DUTIES :—

To assist the management of the Research and Development Branch in co-ordinating and controlling the work of the laboratories. This entails overall planning of research and will involve an appreciation of the economic aspects of large scale research and development.

QUALIFICATIONS AND EXPERIENCE :—

Applicants must have either served a recognised engineering apprenticeship and be Corporate Members of a Senior Engineering Institution or have an Honours Degree in a science subject or have equivalent qualifications. All applicants should have had a wide experience in engineering or science, preferably in a large research organisation, and must be interested in the techniques of management.

SALARY :—Will be assessed within the scale £1300 to £1740 p.a.

A contributory pension scheme is in operation.

Authority houses for renting by successful married candidates may be available in due course, or alternatively, substantial assistance may be given towards legal expenses incurred in private purchase.

Send a postcard for an application form, quoting reference 2022, to the Recruitment Officer, United Kingdom Atomic Energy Authority, Industrial Group Headquarters, Risley, Warrington, Lancashire.

Closing date : 16th September, 1957. E8096

### CITY OF LIVERPOOL

#### CITY ENGINEER AND SURVEYOR'S DEPARTMENT

#### APPOINTMENTS

Applications are invited for the following appointments in the Mechanical Engineering Section :—

(a) CHIEF ASSISTANT (Mechanical Engineering). Salary : £999 7s. 6d. to £1230 per annum. (A.P.T. VII.)

(b) ASSISTANT (Mechanical Engineering). Salary : £707 5s. to £861 per annum. (N.J.C. Scale.)

(c) ASSISTANT (Mechanical Engineering). Salary : £609 17s. 6d. to £691 17s. 6d. per annum. (A.P.T. II.)

Appointment (a) :

Applicants should either be Associate Members of the Institution of Mechanical Engineers or possess an equivalent qualification. A good general engineering background is required, together with some experience of works organisation and management. The person appointed will be required to act as Deputy to the Assistant City Engineer (Mechanical), who is responsible for the organisation of the central engineering workshops ; maintaining a large fleet of vehicles ; mobile civil engineering equipment ; sewage pumps, baling presses and various other items of equipment normally found in a large Municipal undertaking. In addition to mechanical engineering knowledge some electrical engineering experience is desirable.

Appointment (b) :

Applicants must possess a Higher National Certificate in Mechanical Engineering and have had a recognised training in general mechanical engineering, which must include at least 4 years' drawing-office practice. Some knowledge of automobile engineering and vehicle body design is desirable.

Appointment (c) :

Applicants must possess an Ordinary National Certificate in Mechanical Engineering and have had experience similar to that required for (b). The officer appointed will be promoted to the N.J.C. scale (£707 5s. to £861) on obtaining the Higher National Certificate.

Application forms, returnable by 14th September, 1957, obtainable from the City Engineer and Surveyor, Municipal Buildings, Liverpool, 2.

The appointments are superannuable and subject to the Standing Orders of the City Council. Canvassing disqualifies. (J.4899.)

THOMAS ALKER,
E8101 Town Clerk.

### MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

#### CIVIL ENGINEERS

The Civil Service Commissioners invite applications for pensionable posts as ASSISTANT DRAINAGE ENGINEERS. Duties : to deal mainly with schemes in connection with land drainage, water supply and coast protection.

Age at least 25 and under 35 on 1st January, 1957, with extension for regular Forces service and appropriate civil service.

Candidates must : (i) have achieved Corporate Membership of the Institution of Civil Engineers, or (ii) have passed, or been exempted from, examinations necessary for obtaining Corporate Membership ; such candidates would be expected to qualify under (i) in due course. All candidates must have qualified in the subject " hydraulics."

London salary scale (men) : £805 (age 25) to £1250. Starting salary according to age, up to £1085 at 34 or over. Lower rates outside London. Prospects of promotion to higher grades on salary scale £1280–£1720 and £1780–£2050 and above. Women's salaries lower but being raised to reach equality with men's by 1961.

Further particulars and application forms from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S 64–65/57.

Interview Board held at intervals, as required. Early application advised. E8162

Classified Advts. continued on page 4

XUM

## PUBLIC APPOINTMENTS

### UNITED KINGDOM ATOMIC ENERGY AUTHORITY (RESEARCH GROUP)

#### PROTON SYNCHROTRON FOR THE NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

#### PHYSICISTS AND ENGINEERS

The United Kingdom Atomic Energy Authority (Research Group) invite applications from PHYSICISTS and ENGINEERS for a number of posts in the project team concerned with the design, construction and commissioning of a 7,000 million Electron Volt Proton Synchrotron at Harwell, Berkshire.

RESEARCH AND DEVELOPMENT.

Physicists and electrical engineers will be recruited in the Scientific and Experimental Officer Classes. Knowledge of "Particle Accelerators" is not essential, though experience in one of the following fields is desirable :

Electro magnets or transformers ;
Heavy duty electrical machinery, rectifiers and switchgear ;
Radiofrequency systems especially in the range 1/100Mc/s ;
High vacuum systems and associated monitoring and control equipment ;
Electronics, including control circuits and instruments of all kinds.

ENGINEERING DESIGN, CONSTRUCTION AND MAINTENANCE.

Senior posts are available for engineers with proved ability in similar large development projects preferably but not essentially of an electro mechanical nature. The right experience for other responsible posts will have been obtained by engineers trained in any of the following :

Heavy electrical plant and equipment installations;
Plant and equipment for research and development;
Complex central circuitry;
Test plants for switchgear or rotating machines;
Rectifier systems;
Steel works.

Salaries : (depending upon age, qualifications and experience) ; Scientific Officer and Engineer classes, up to £2080 ; Experimental Officer class, up to £1630.

For further details and an application form, please send a postcard to : Recruitment (905/25), A.E.R.E., Harwell, Didcot, Berks. E8098

### CENTRAL ELECTRICITY AUTHORITY

#### NORTH EASTERN DIVISION

#### OPERATIONAL RESEARCH SECTION

#### THIRD ASSISTANT ENGINEER

Applications are invited for the appointment of THIRD ASSISTANT ENGINEER in the Operational Research Section of the Generation (Operation) Department, with Headquarters at Stella North Power Station, near Newcastle upon Tyne.

The work of the Section involves the application of Operational Research Techniques to Power Stations for the purpose of increasing plant availability and improving the efficiency of Operation Maintenance.

Applicants should be qualified mechanical or electrical engineers and previous experience of Operational Research is desirable, but not essential, as there will be opportunities for special training.

The salary for the appointment (which is superannuable) will be in accordance with the National Joint Board Agreement, Schedule "B," Grade 4 (£895–£1110 per annum), and will commence at a point commensurate with qualifications and experience.

Forms of application may be obtained from Divisional Establishments Officer, Central Electricity Authority, North Eastern Division, Carliol House, Newcastle upon Tyne, 1, to whom they should be returned to arrive not later than 17th September, 1957. E8137

### FORESTRY COMMISSION

#### DIRECTORATE ENGINEER (SCOTLAND)

The Civil Service Commission invite applications for this pensionable post. The Directorate Engineer is responsible for the direction of all Forestry Commission engineer work in Scotland and is the Engineer Adviser to the Director of Forestry for Scotland. Age at least 35 on 1st July, 1957. Candidates must have achieved Corporate Membership of the Institution of Civil Engineers and had extensive experience in the planning and control (including finance) of engineering work, particularly road work, including bridges. Experience of modern earth-moving equipment essential. Salary : £1242 to £1670. Car driving necessary.

Particulars and application forms from the Secretary, Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S4751/57. Applications should be returned by 24th September, 1957. E8161

### DOVER HARBOUR BOARD

#### CIVIL ENGINEERING ASSISTANT

Applications are invited for the post of CIVIL ENGINEERING ASSISTANT in the Chief Engineer's Department at the Dover Harbour Board.

Applicants should be associate Members or Graduates of the Institution of Civil Engineers or hold equivalent qualifications.

Salary according to age and experience.

Applications, stating age, qualifications, particulars of previous experience and present appointment, should be forwarded to The General Manager, Dover Harbour Board, Harbour House, Dover. E8124

## PUBLIC APPOINTMENTS

### NEWCASTLE REGIONAL HOSPITAL BOARD

#### APPOINTMENTS

Applications are invited for the following posts.

(a) SENIOR ASSISTANT ENGINEER (MECHANICAL) :
Salary : £1010 by £30 (5) by £35 (1) to £1195 per annum. Applicants must be Corporate Members of the Institution of Mechanical Engineers and should be expert draughtsmen with wide experience in design, drawing up of plans and specifications for mechanical engineering equipment in hospitals, including steam boiler plants, heating and hot water pipe work.

(b) ASSISTANT ENGINEER (HEATING AND VENTILATING) :
Salary : £700 by £25 (3) by £30 (1) by £35 (6) to £1015 per annum. Applicants should be Associate Members of the Institution of Heating and Ventilating Engineers or have passed appropriate sections of the Associate Membership Examination of the Institution of Mechanical Engineers. Candidates must be expert draughtsmen with experience in design, drawing up of plans and preparation of estimates and specifications for all types of central heating, domestic hot water and full air conditioning installations.

(c) CLERK OF WORKS :
Salary : £635 by £20 (2) by £25 (3) to £750 per annum. Applicants must have served an apprenticeship in mechanical or electrical engineering and have had not less than five years' experience supervising site installations employing trades associated with mechanical and/or electrical engineering.

Applications, stating age, qualifications, experience, present and previous appointments and salary, together with names and addresses of three referees (two technical), should be forwarded to the Secretary, Newcastle Regional Hospital Board, Benfield Road, Newcastle upon Tyne, 6, within 14 days. E8134

### THE WINTERTON HOSPITAL MANAGEMENT COMMITTEE

#### WINTERTON MENTAL HOSPITAL

#### SENIOR ENGINEER

The Winterton Hospital Management Committee invite applications for the post of SENIOR ENGINEER at the Winterton Mental Hospital, Sedgefield, Stockton-on-Tees, Co. Durham.

Applicants must have completed an apprenticeship in mechanical engineering (as distinct from a wholly craft apprenticeship) or have otherwise acquired a sound practical training in mechanical engineering.

They must have a sound knowledge of the principles and practice of the efficient operation of institutional boiler plants and engineering services generally, and also possess electrical experience, including generating plant.

Applicants must have passed an examination in engineering technology and hold one of the following or higher qualifications or an equivalent qualification approved by the Minister of Health :—

First Class Certificate of Competency in Marine Engineering or equivalent Naval Certificate.

City and Guilds Full Technological Certificate in Plant Engineering (First Class) (from 1957).

The successful applicant will be required to deputise for the Superintendent Engineer. The post is non-resident.

The appointment will be subject to the National Health Service Superannuation Regulations and Whitley Council conditions of service. Salary will be £740 by £25 (2) by £30 (3) to £880.

Application forms obtainable from the undersigned and to be returned not later than 30th September, 1957.

C. W. GILL,
Group Secretary.
Winterton Hospital Management Committee,
Sedgefield, Stockton-on-Tees,
Co. Durham. E8157

### CENTRAL ELECTRICITY AUTHORITY

#### RESEARCH LABORATORIES, LEATHERHEAD, SURREY

#### CARTOGRAPHIC TRACER-DRAUGHTSMAN (OR DRAUGHTSWOMAN)

Central Electricity Authority, Research Laboratories, Leatherhead, Surrey, require a CARTOGRAPIC TRACER-DRAUGHTSMAN (or DRAUGHTSWOMAN) to assist in the preparation of linen reproduction drawings for research reports, lantern slides, &c. Salary £500–£600 p.a., according to ability.—Applications, stating age, qualifications and experience, to D. Moffat, Director of Establishments, Winsley Street, London, W.1, by 6th September, 1957. Quote reference ENR./371. E8116

### LONDON TRANSPORT

#### CHISWICK WORKS

#### ENGINEERING ASSISTANT

London Transport require ENGINEERING ASSISTANT for Mechanical Side of Plant Section, Chiswick Works.

Qualifications : Practical workshop training ; experience in design and details of items of plant services ; ability to prepare specifications and detailed estimates.

Salary range : £790–£880. Free travel. 5-day week.

Applications within 14 days to Recruitment and Training Officer, F/EV 654, London Transport, 55, Broadway, S.W.1. E8104

## PUBLIC APPOINTMENTS

### STAFFORDSHIRE POTTERIES WATER BOARD

#### APPOINTMENT OF CIVIL ENGINEERING ASSISTANTS AND MECHANICAL ENGINEERING DRAUGHTSMAN

Applications are invited for the following appointments :—

(a) CIVIL ENGINEERING ASSISTANTS, Grade A.P.T. V (£814 17s. 6d. to £994 5s. per annum). Applicants should be Corporate Members of the Institution of Civil Engineers and preferably had experience in the design and construction of waterworks.

(b) One MECHANICAL ENGINEERING DRAUGHTSMAN, Grade A.P.T. III (£656 to £784 2s. 6d. per annum). Applicants should be neat and expeditious draughtsmen, with a knowledge of plant layout.

For appointments (a) the Board will provide housing accommodation to the successful candidates, if required.

Reasonable removal expenses will be allowed by the Board.

The appointments are subject to the provisions of the National Scheme of Conditions of Service ; to the provisions of the Local Government Superannuation Act, 1937 ; to termination by one month's notice on either side, and to the successful candidates passing a medical examination.

The Board have considerable major works in hand, giving opportunities of preparing designs, specifications and supervising contracts for varied types of work.

Applications, stating age, full details of training, qualifications, present and previous appointments, details of experience, together with copies of two recent testimonials, or the names of two persons to whom reference can be made, and clearly stating for which post they are applying, should be forwarded to the undersigned not later than Saturday, 14th September, 1957.

C. V. BROWN, M.I.C.E., M.I.Mech.E., M.I.W.E.,
Engineer and Manager and Clerk.
Albion Street,
Hanley,
Stoke-on-Trent. E8167

### MANCHESTER CORPORATION WATERWORKS UNDERTAKING

#### ASSISTANT ENGINEER (CLASS I)

Applications are invited for the appointment of ASSISTANT ENGINEER (Class I), to be employed on the design and construction of two large rapid gravity filtration plants and associated treatment works, at a commencing salary within the range of £1000/£1350 per annum, according to qualifications and experience.

Housing accommodation is available at a reasonable rental.

Applicants must be Corporate Members of the Institution of Civil Engineers and have experience of the construction of large-scale civil engineering works. The appointment will be to the temporary staff and is superannuable.

Applications, stating age, education and training, professional qualifications and experience, together with the names of two referees, should be addressed to the Engineer and Manager, Waterworks Offices, Town Hall, Manchester, 2, so as to be received by 16th September, 1957. E8042

## TENDERS

### COUNTY BOROUGH OF BRIGHTON

#### WATERWORKS DEPARTMENT

#### RESERVOIR LEVEL INDICATORS AND RECORDERS

TENDERS invited for SUPPLY, DELIVERY and SETTING TO WORK of ELECTRO-MECHANICAL EQUIPMENT for REMOTE INDICATION and RECORD of WATER LEVEL at THREE RESERVOIRS.

Conditions of Contract, Specification and Form of Tender obtainable from Waterworks Engineer, 12, Bond Street, Brighton. Deposit of £2 2s. will be refunded on receipt of bona fide Tender and return of documents supplied.

Tenders enclosed in plain sealed envelope not bearing any name or mark indicating the sender and endorsed "Tender for Reservoir Level Recorders" to be delivered to me before Saturday, 14th September, 1957.

The Corporation do not bind themselves to accept the lowest or any Tender.

W. O. DODD,
Town Clerk.
Town Hall,
Brighton.
16th August, 1957. E8068

### INDIA STORE DEPARTMENT

#### HYDRAULIC PRESS

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of :—

One (No.) HYDRAULIC PRESS and AUXILIARIES for Extruding Lead and Aluminium Wire. Capacity 894 tons. The wire to be used in the manufacture of small arms ammunition.

Tender schedules and specifications may be obtained from the above address at a fee of ten shillings, which is not refundable. Cheques should be made payable to High Commission of India. The applications for Tender forms should state reference 2008/57/ENG.3.

Tenders, complete with specifications, are to be submitted by Monday, the 21st October, 1957. E8169

## TENDERS

### INDIA STORE DEPARTMENT

#### AUTOMATIC MACHINES

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of :—

One off—4-Spindle BAR AUTOMATIC MACHINE. Maximum capacity : Round 67mm. ; Square 47mm. ; and Hexagon 58mm. — Ref. No. 2070/57/ENG.3.

Two off—SCREW AUTOMATIC MACHINE., capacity 50mm.

One off—SCREW AUTOMATIC MACHINE, capacity 75mm. — Ref. No. 2063/57/1/ENG.3.

Tender schedules and specifications may be obtained from the above address at a fee of ten shillings per set, which is not refundable. The cheques should be made payable to High Commission of India. The applications for Tender forms should state description of machine and corresponding reference for which schedules are required.

Tenders, complete with specifications, are to be submitted by Monday, the 21st October, 1957. E8171

### INDIA STORE DEPARTMENT

#### PRECISION JIG BORING MACHINE

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of :—

One (No.) PRECISION JIG BORING MACHINE, table working surface 406 × 762mm. Longitudinal table travel 609mm. Table traverse 457mm. Spindle quill travel 228mm.

Tender schedules and specifications may be obtained from the above address at a fee of ten shillings, which is not refundable. Cheques should be made payable to High Commission of India. The applications for Tender forms should state reference 2061/57/ENG.3.

Tenders, complete with specifications, are to be submitted by Monday, the 21st October, 1957. E8170

## EDUCATIONAL

### MIDDLESEX COUNTY COUNCIL EDUCATION COMMITTEE

#### ENFIELD TECHNICAL COLLEGE, QUEENSWAY, ENFIELD, MIDDLESEX

Applications are invited for admission to Full-Time SANDWICH DIPLOMA COURSES in CIVIL, ELECTRICAL, GAS, MECHANICAL and PRODUCTION ENGINEERING, in FOREMANSHIP and SUPERVISION and in MANAGEMENT STUDIES.

Full details of the Courses may be obtained on application to the Principal at the College.

C. E. GURR, M.Sc., Ph.D.,
Secretary to the Education Committee. E7641 x

### THE POLYTECHNIC 309, REGENT STREET, W.1.

#### CIVIL AND MECHANICAL ENGINEERING DEPARTMENT

Head of Department : R. W. STEED, B.Sc. (Eng.), Ph.D., A.M.I.C.E., A.M.I.Mech.E.

EVENING COURSES are held for the Award of National Certificates in Civil and Mechanical Engineering and offer preparation for the examinations of the professional institutions.

Courses are also held in Engineering Workshop Practice.

Session begins on 23rd September, 1957. New students will be enrolled on Wednesday, 18th September, 5–8 p.m.

Prospectuses may be obtained on application to the Director of Education. E8080 x

**A.M.I.MECH.E., B.Sc.,** City and Guilds, &c. Guaranteed Postal Courses for all Exams., and Technical Divisions from Elementary to Degree standard. Approximately 95 per cent successes. 144-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E721 x

**FREE !** Brochure giving details of Courses in Mechanical and Production Engineering, Draughtsmanship, &c., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other Professional examinations. —E.M.I. Institutes, Dept. E30, London, W.4. (Associated with H.M.V.) E972 x

**WORK STUDY.**—Part-time (evenings) 20 weeks' Diploma Course starts September 9th. Enrolments open now.—Details of this and five other courses, including full-time (six weeks) and correspondence, from School of Time and Motion Study, 29, Cork Street, W.1. Regent 0516. E7617 x

## SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED

**A CHIEF DRAUGHTSMAN** is required for a well-known firm of Structural and Mechanical Engineers in India. Applicants should be over thirty-five years of age, must have had a first-class education, be competent structural designers, and have the necessary experience to enable them to take complete control of a large drawing-office with both Structural and Mechanical Sections. Four-year contract, salary equivalent to £225 monthly, leave on full pay, provident fund, free passages for family, medical attention and free unfurnished quarters.—Apply by letter only, stating age and giving full particulars of education and practical experience, to BOX No. 1102, c/o Charles Barker and Sons, Ltd., Gateway House, London, E.C.4. E8111 A

## SITUATIONS VACANT

**A SALESMAN/DEMONSTRATOR** required, free to travel extensively in U.K. driving a van in which a Clayton steam generator has been installed for demonstration purposes. Training given to acquire full knowledge of this type of generator now being made in this country under licence from America. Desirable qualifications include suitable technical education, some electrical knowledge, experience of steam generators and connections with users of such equipment and heating engineers. Appointment pensionable.—Written applications in confidence to Secretary, The Vulcan Foundry, Limited, Newton-le-Willows, Lancashire, giving age, remuneration expected, and full details of career and qualifications. E8159 A

**A UNIQUE OPPORTUNITY** has arisen for an ENGINEER to undertake research and development work on the cold forming of a range of steel components which have not previously been manufactured in this way. The position offers considerable prospects to a graduate (or equivalent) who is capable of original work and is interested in fundamental and applied research. The work will be undertaken in a new building of modern construction and in pleasant surroundings. Good pension scheme and other facilities. Apply in confidence giving details of qualifications, experience and present salary.—BOX No. E8035, "The Engineer." A

**ALLENS OF BEDFORD**
have a vacancy in
**THE DEPARTMENT OF THE WORKS ENGINEER**
for
an ASSISTANT, who would be responsible to the Works Engineer for the design and maintenance of buildings and plant. Candidates should have a good technical training, H.N.C. or equivalent qualification. Good all-round practical experience is desirable. Up-to-date experience with the design of modern industrial buildings essential.

This post is interesting and will involve increasing responsibility.

Generous pension scheme ; assistance towards moving expenses.

Apply, stating age, and full details of experience to the Personnel Manager, W. H. Allen, Sons and Co., Ltd., Queens Engineering Works, Bedford. E8052 A

**ASSISTANT PLANT ENGINEER**

The Empire Aluminium Company Limited, who are associated with Venesta Limited, require an Assistant Plant Engineer for their Glasgow factory. Applicants should be over 30 years of age, be at least Graduate Members of the Institution of Mechanical Engineers or possess an equivalent qualification, and have sound experience of plant layout and maintenance. The successful candidate will be required to plan and supervise substantial cold rolling installations at Glasgow and subsequently maintain the plant installed. There are good prospects of promotion for the right man. For the first eighteen months of the project the successful candidate will be required to work at the London factory of Venesta Limited to familiarise himself with the plant involved. Starting salary will be about £1200 a year.

Applications should include full details of qualifications, experience and present salary and be addressed to the Personnel Manager, Venesta Limited, North Woolwich Road, Silvertown, E.16. E8103 A

**ASSISTANT TECHNICAL OFFICERS** (Draughtsmen) are required by IMPERIAL CHEMICAL INDUSTRIES LTD., Dyestuffs Division, at Manchester and Huddersfield, for design work in connection with new projects for the manufacture of synthetic fibres, synthetic resins and other chemicals. Applications are invited from Mechanical Engineering Draughtsmen with good technical qualifications (Higher National Certificate minimum) and preferably with general engineering design experience.—Applications should be made in the first instance to Staff Department, Hexagon House, Blackley, Manchester, 9. E8097 A

**ATOMIC POWER CONSTRUCTIONS, LIMITED**

Opportunities exist for SENIOR and JUNIOR DESIGN DRAUGHTSMEN, for interesting new work on large nuclear power station projects. The work is rapidly expanding and prospects for promotion within the organisation are good.

The qualifications required are initiative and experience appropriate to age in one of the following categories :—

(1) Pressure vessel design.
(2) Reactor engineering. Experience with intricate mechanisms in any branch of light/medium engineering is likely to be useful.
(3) Power station layout and pipework.
(4) Power station electrical equipment.
(5) Cabling and wiring.
(6) Instrumentation and control.

Successful applicants enter the staff pension scheme immediately. Reasonable removal expenses paid.

Applications, which will be treated in confidence, should state age, qualifications, experience and salary expected, and should be addressed to :

The Secretary (Ref. CE),
Atomic Power Constructions, Ltd.,
28, Theobalds Road,
London, W.C.1. E8144 A

**ASSISTANT TO TECHNICAL ENGINEER.** Age 21/25. Must have some drawing-office experience. O.N.C. in Mechanical Engineering desirable. Knowledge of hydraulics and/or automotive engineering an advantage.—Apply in writing, with full particulars and salary expected, to Secretary, E. P. Barrus, Ltd., 12–16, Brunel Road, London, W.3. E1152 A

**ATOMIC ENERGY.**—A Senior qualified MECHANICAL ENGINEER with connections in the Industrial and Chemical Engineering Market, is required to further this company's interest in the Atomic Energy field and the application of specialist fabrication. Applications should provide full details of past experience and present salary level, and will be treated in confidence.—Replies to Personnel Officer (Ref. A.E.), The A.P.V. Co., Ltd., Crawley, Sussex. E8100 A

**BLACKBURN (DUMBARTON), LTD.**
require
a DESIGNER for light structural engineering work. Applicants must have previous experience in design of metal frame structures.

The successful applicant will be responsible for the development of new projects. This position offers wide scope for man with initiative and original ideas.

Membership of a recognised engineering institute would be an advantage. Commencing salary not less than £1250, dependent on qualifications and experience. Contributory pension scheme in operation ; assistance with housing if required.

Applications, not later than 14th September, 1957, stating details of experience, qualifications, age, &c., to be addressed to Personnel Manager, Blackburn (Dumbarton), Ltd., Castle Road, Dumbarton. E8141 A

**BOOTS PURE DRUG CO., LTD.**
**ENGINEERING DEPARTMENT**

Boots Pure Drug Co., Ltd., invite applications from GRADUATE MECHANICAL ENGINEERS for a progressive position that will result from the development of Work Study throughout the Engineering Department.

This department, which employs over 600 people, comprises nine separate sections, each under its own Works or Section Engineer, responsible to the Chief Engineer for the installation, maintenance and repair of mechanical and electrical equipment in our Pharmaceutical, Chemical, Printing and other works and warehouses ; for the development and construction of much special purpose plant and for the design, specification and operation of all engineering services, including the generation and distribution of steam and electricity from our two Power Stations.

Applicants, who should be not more than 35 years of age, should have had a thorough works training, preferably followed by some years' experience in the Pharmaceutical, Chemical or Food Manufacturing Industry. Experience in Work Study would be a further advantage, but training would, if necessary, be given in this, as well as in other aspects of the department's work.

Application, giving full details of education, training and career to date, should be sent to the Personnel Manager, Station Street, Nottingham. E8123 A

**BRITISH MANUFACTURE AND RESEARCH CO., LTD.,** an associate of Hispano-Suiza, require DESIGN AND DETAIL DRAUGHTSMEN for NEW LIGHT GUNNERY AND FIRE CONTROL PROJECTS of international importance.

Initiative and ability to work on mechanical and electrical units with minimum supervision is valued ; specific experience of gunnery equipment design not essential.

The company offers excellent welfare facilities and a voluntary pension scheme.—Written applications, stating age, qualifications, experience and salary required, to British M.A.R.Co., Ltd., Grantham, Lincs., quoting ref. AWK/STAFF/E. E1176 A

**BRITISH OXYGEN GASES LIMITED**
require a qualified
**ELECTRICAL ENGINEER**
for work in their Sales Technical Department. The work is in connection with prototypes of electrical power units used in connection with electrical welding equipment. A young Engineer who has recently qualified, having completed a good apprenticeship, and wishes to pursue a commercial career, would be suitable. Age range 24–30.

Write, giving details, to Personnel Manager, Bridgewater House, Cleveland Row, St. James's, S.W.1. E8115 A

**BRITISH PETROLEUM COMPANY, LTD.,** has a vacancy at its Aden Bunkering Installation for a MECHANICAL ENGINEER. Applicants, aged 25–35, must possess at least O.N.C., and have served a mechanical engineering apprenticeship with subsequent experience of running and maintenance of large C.I. engines, centrifugal pumps and ancillary machinery. Experience in engineering planning procedure is essential and a knowledge of large storage tank work is desirable. Attractive salary plus generous allowance in local currency, kit allowance, free medical attention, free passages out and home, good leave arrangements. Pension scheme.—Write, giving full details, quoting F.542, to BOX 2018, c/o 191, Gresham House, E.C.2. E8148 A

**BRITISH PETROLEUM COMPANY, LTD.,** has vacancies for ENGINE FITTERS for duty in exploration project in the PERSIAN GULF. Applicants, aged 22–28, should have completed an apprenticeship in diesel engineering. Experience in maintaining various types of diesel engines, pumps and air compressors is desirable. Experience in air conditioning and refrigeration an advantage. Possession of O.N.C. (Mech.) is also desirable. Short leave in the U.K. after six months. Attractive salary plus generous allowances, free passage out and home, kit allowance, free medical attention, good leave arrangements.—Write, giving full details of qualifications and experience, quoting reference F.541, to BOX 2020, c/o 191, Gresham House, E.C.2. E8149 A

**BRITISH PETROLEUM COMPANY, LTD.,** has vacancies for MECHANICAL CONSTRUCTION ENGINEERS. Applicants, aged 25–35, must have at least H.N.C. in Mechanical Engineering and Corporate Membership of Institution of Mechanical Engineers is desirable, with experience on construction of civil and mechanical projects, preferably with contractors in a supervisory capacity. Should be accustomed to organising works sections and have some knowledge of contract documents and control of expenditure. Employment will be initially in the U.K. but successful candidates must be prepared to do terms of service abroad from time to time. Salary according to qualifications and experience. Non-contributory pension fund. Assisted house purchase scheme, removal expenses and settling-in allowance payable in certain cases. Luncheon club.—Write, giving full particulars, quoting H.3893, to BOX 5412, c/o 191, Gresham House, E.C.2. E8089 A

**BRITISH PETROLEUM COMPANY, LTD.,** has vacancy for a CONSTRUCTIONAL ENGINEER for service overseas. Applicants, aged 26–30, must have at least H.N.C., but B.Sc., A.M.I.C.E. or equivalent desirable with subsequent field experience on construction of civil or mechanical projects, preferably with contractors, in supervisory capacity. Accustomed to organising works sections and with some knowledge of the preparation of contract documents and control of expenditure. Attractive salary plus generous allowance in local currency, kit allowance, free medical attention, free passages out and home, good leave arrangements. Pension scheme.—Write, stating age and full details of qualifications and experience, quoting F.528A, to BOX 2024, c/o 191, Gresham House, E.C.2. E8150 A

**CHIEF DESIGNER** required by well-established manufacturers of range of food machinery, Eastern Counties. Applications stating age, full details of past experience, and salary required are invited.—BOX No. E1158, "The Engineer." A

**CONSULTING ENGINEERS** have vacancy in their Glasgow Office for ENGINEER with experience of power station design and construction, to be responsible for the planning and co-ordination of work on a large nuclear project. Applicants should have a Degree in Electrical or Mechanical Engineering or be Associate Members of one of the leading Engineering Institutions.—Applications should be sent to Kennedy and Donkin, 4, Somerset Place, Glasgow. Reference EJE. E8094 A

**DESIGN DRAUGHTSMEN.**—The British Drug Houses, Ltd., invite applications from suitably qualified men for interesting work in the Engineers Drawing Office, on special machines and plant layouts for the Light Chemical Industry. H.N.C. in Mech. Eng. and previous experience in this industry desirable but not essential. Men of mature age with suitable training and experience, would be considered. Five-day week, pension and profit-sharing schemes.—Write, stating age, experience and salary required, to Staff Manager, Graham Street, N.1. E7871 A

**DESIGN ENGINEER** required by company embarking on new projects. Must be capable of initiating and developing designs.—BOX No. E8121, "The Engineer." A

**DESIGN ENGINEERS**

Applications are invited from qualified mechanical or chemical engineers with experience of design in the chemical plant or a related field of work.

Important new posts are available involving responsibility for complete design of large-scale plants and associated equipment in a field presenting interesting and unusual design problems.

These appointments offer good promotion prospects, together with excellent salaries and conditions of service, including assistance with housing, where appropriate.

Applications, giving full details of age, qualifications, experience and salary required, to :—

Staff Officer,
British Oxygen Engineering, Limited,
Angel Road, Edmonton, N.18.
Telephone No. Edmonton 3020.

E8143 A

**DESIGNER-DRAUGHTSMAN,** with experience water-tube boilers, required for newly formed company, south of London. Good prospects and salary.—BOX No. E1080, "The Engineer." A

**DRAUGHTSMAN,** Senior, Structural, required for small but expanding drawing-office, West London area. Full details.—BOX No. E8138, "The Engineer." A

**DRAUGHTSMEN** required in the following categories : Senior and Junior Piping and Instrumentation ; Senior and Junior Reinforced Concrete ; Senior Mechanical, by engineers in City engaged on nuclear, petroleum, chemical plants. H.N.C./O.N.C. desirable. Salaries above average, five-day week, pension/life assurance and personal accident schemes, house purchase assistance, luncheon vouchers.—Write full particulars to Head Wrightson Processes, Ltd., 24/26, Baltic Street, E.C.1. E954 A

**DRAUGHTSMEN** required for General Engineering Works in Huddersfield district. Preferably accustomed to steelworks plant, but applicants with general experience considered. Good prospects and salary to suitable men. Superannuation scheme in operation. Please state full details of experience.—BOX No. E1179, "The Engineer." A

**DRAUGHTSMEN** (Mechanical) required by Ransome and Marles Bearing Co., Ltd., Newark-on-Trent, Notts. The work is both interesting and varied, covering an extremely wide field of engineering, therefore we invite Senior Draughtsmen with a sound and widest possible mechanical experience to apply. The conditions of working are very good. Full welfare facilities, including a staff superannuation scheme, are in operation. The posts offered are permanent, with ample scope for advancement, and the salary is commensurate with ability and experience —Write, giving full details age, experience and salary required. E8092 A

**ELECTRICAL ENGINEER**
required for Tyneside STEEL SECTION MILLS. To be solely responsible for Electrical Maintenance Staff.

A satisfactory take over period will be afforded with the present Engineer, who is retiring after many years' service with the company.

Applicant should supply evidence of sufficient theoretical training and practical experience in both D.C. and A.C. operation.

Salary and other details by arrangement.—BOX No. E1173, "The Engineer." A

**ENGINEER** required with good experience of marine engine-fitting and erection to undertake the co-ordination of manufacture of components for heavy pulverising equipment and ultimate supervision of erection at various sites throughout the country. The position offers first-class opportunity for man having some office experience, together with practical experience of gearing and bearing alignment, &c. The job will entail short spells at site but essentially will require residence in London.—Write fully, giving full particulars of age, experience and present salary, to BOX No. 1106, c/o Charles Barker and Sons, Ltd., Gateway House, London, E.C.4. E8112 A

**ENGINEER** required with experience in the manufacture of Air Conditioning Units. Must have had previous experience in design and building of specialised air conditioning units. Good salary and prospects for right man. Send full particulars in writing to Managing Director.—BOX No. E8126, "The Engineer." A

**ENGINEER,** aged 22 to 30, electrical or electronic, preferably university trained, required by Liverpool consultants for training in a most exclusive and underpopulated profession. Excellent salary and prospects and congenial conditions of employment. State experience and present salary.—BOX No. E1163, "The Engineer." A

**ENGINEER,** aged 28–32 years, with Degree or Higher National Certificate, required to join team engaged on research into vibration of machine tools. A knowledge of electronics would be an advantage. Previous experience on vibration research not essential ; suitable applicant will be trained. Send full details, including present salary, in confidence.—BOX No. E8051, "The Engineer." A

**ENGINEER BUYERS AND REPRESENTATIVES' ASSOCIATION** (Limited by Guarantee). The Council of this dominant professional organisation can fill vacancies for Engineer Buyers and Engineer-Representatives (no fees—employers or members)—and to consider application for membership from qualified Buyers and Representatives associated with the Engineering and Allied Trades.—Write E.B.R.A., 47, Victoria Street, London, S.W.1. Tel.: ABB 3583 (Employment Licence No. 6063). Licensed annually by the L.C.C. E627 A

**ENGINEERS** are required to work on the design and development of production plant for the manufacture of brake and clutch linings. Duties require an ability to follow jobs through all stages of development until designed performance of production plant is obtained and operatives for the plant are trained. Applicants must hold at least H.N.C. in Mechanical Engineering or equivalent, and have had works and drawing-office training with good experience in general plant design.—Write, stating age, education, qualifications and salary required, to the Personnel Manager, Ferodo Limited, Chapel-en-le-Frith, Via Stockport. E8023 A

**ENGINEERS** with specialised training in the design and execution of prestressed concrete projects are required for permanent employment in Rhodesia and the Union of South Africa. Free passages, pension scheme, excellent prospects.—Full details to BOX JY/29, c/o 95, Bishopsgate, London, E.C.2. E973 A

**ENGINEER-DESIGNER**

Engineering Company located in London requires the services of a first-class Engineer-Designer to take charge of drawing-office with 10/15 draughtsmen. Applicants must have a sound practical and theoretical engineering training and be fully familiar with modern drawing-office routine and organisation. The company specialises in the production of machinery and equipment for the food and chemical industries, mainly in stainless steel, and experience in this class of work would be an advantage. The company's activities are expanding and the position has excellent prospects for a man who has plenty of enthusiasm and drive combined with a sound engineering knowledge. The salary would be in the four-figure range and the company operates a non-contributory pension scheme. Please reply with full details, age, education and training.—BOX No. E8166, "The Engineer." A

**ENGINEER/DRAUGHTSMAN** required for Mechanical Plant Development.—Application, giving details of qualifications and experience, should be addressed to Personnel Manager, Holland & Hannen and Cubitts, Ltd., 1, Queen Anne's Gate, London, S.W.1. E8015 A

**ENGINEER REPRESENTATIVE,** basic mechanical engineering background and commercial experience desirable. High and low-pressure pipework fabrication and installation, medium heavy forgings, required for North-West area, with occasional visits to Midlands. Applicant would be required to be based in Manchester area. State age, experience and salary required.—BOX No. E1142, "The Engineer."

**Classified Advts. continued on page 6**

XUM

## SITUATIONS VACANT

**ENGINEERING CLERK OF WORKS** required for site supervision of large steam boiler plant with distribution mains in Bristol. Duration of contract approximately two years. Salary £850 per annum for man with at least fifteen years' engineering experience since completing his apprenticeship in mechanical engineering.—Write, stating age and experience, to Hoare, Lea and Partners, 21, Oakfield Road, Bristol, 8, marking envelope "Clerk of Works." E1184 A

**ENGINEER SURVEYOR** required for inspection of boilers and pressure vessels. Applicants must possess First Class M.O.T. Certificate Steam or equivalent. Salary £735, rising to £1060, E.S.A. Scale. Other attractive emoluments. North and East London areas.—Apply, Engineering Dept., General Assurance Corpn., 99, Aldwych, W.C.2. E8145 A

**ETHIOPIA.**—British Merchant House wish to appoint Manager of their Engineering Department. Applicants should have had good sales, technical and administrative experience in general engineering. Position offers excellent prospects for a man of initiative and energy. Accommodation available, free air passages, home leave, non-contributory pension scheme.—Write, BOX AU/98, c/o 95, Bishopsgate, E.C.2. E8147 A

**EXPERIENCED ESTIMATORS** required for Engineering Works, for the preparation of labour and material estimates in connection with Iron and Steel Works Plant, including Rolling Mills and their auxiliaries. Persons accustomed to taking responsibility and able to work from prepared schemes and with sound experience in general engineering. Excellent prospects and salary paid to the right personnel. Superannuation scheme in operation.—State full details of experience to B. Thornton Ltd., Engineers, Huddersfield. E8090 A

**FORD MOTOR COMPANY LIMITED AND BRIGGS MOTOR BODIES LIMITED**

have vacancies for

**COST ANALYSIS ENGINEERS**

relative to :
PRESS WORK
GENERAL MACHINING
FORGING and
DIE CASTING

These are positions of some responsibility for Engineers of O.N.C. standard, having practical experience in mass-production techniques and able to estimate costs for a wide range of components.

Applicants must possess a knowledge of modern manufacturing methods, work standards, industry practices and commodity markets in which the company buys, and be able to express themselves clearly by verbal and written communication.

Selection will be made from candidates around 25/30 years of age.

Successful applicants will have opportunities for advancement dependent only upon individual ability and approach.

Please write to Training and Recruitment Department, Ford Motor Co., Ltd., Dagenham, Essex, giving details of age, experience and qualifications, and quoting reference CEA. Envelopes should be marked 012A. E8154 A

**GENERAL SUPERINTENDENT** (European), required for large well-established British-owned factory in Calcutta manufacturing a wide range of electric motors, transformers, switchgear, &c. Must have had considerable experience in charge of shops producing similar equipment. Knowledge of latest manufacturing methods and processes, and ability to organise operations for fast and economical production essential. The man appointed will be required to plan and install an efficient piecework system in the factory where only day-work has been in operation up to the present, and good experience of the introduction and operation of piecework systems is essential. Age 30-40. Salary before tax including dearness allowance 3,300 rupees per month, plus travelling expenses, free passage to India including wife and family, free accommodation and medical attention. Appointment will be subject to a three-year renewable contract.—Reply with names of references to Secretary, A.E.I. Overseas, Ltd., Crown House, Aldwych, London, W.C.2. All applications will be treated in confidence. E1160 A

**IMPERIAL CHEMICAL INDUSTRIES LIMITED**

Alkali Division
Winnington, Northwich, Cheshire.

**STRUCTURAL AND CIVIL ENGINEERING DESIGNERS**

Vacancies exist in our Civil Engineering Department for Assistant Technical Officers to work as Structural and Civil Engineering Designers. Applicants, age 25–40, should possess H.N.C. and have had experience either in structural work or in reinforced concrete and general building work.

First-class working conditions and recreational facilities. Five-day week. Contributory pension fund and profit-sharing schemes. Married men can receive limited assistance with removal expenses, including railway fares. Assistance in house purchase, facilities being available in approved cases for substantial loans, with, in addition, an advance for legal charges. A lodging allowance may be paid for a period not exceeding six months to married men whilst maintaining two homes.

Write for official application form to Staff Manager, quoting reference GES/STRUCT. E8130 A

**HEAT TRANSFER AND FLUID FLOW.**—RESEARCH AND DEVELOPMENT ENGINEER required by an old-established engineering company in the Glasgow area. Applicants, aged 25–30, should have a University Honours Degree in Engineering and some research experience. The work would involve the theoretical design and practical testing of new types of heat exchanger. A good salary would be paid to an applicant with the necessary qualifications. Apply, giving age and full particulars.—BOX No. E788, "The Engineer." A

**HYDRAULIC SALES ENGINEER**

We are looking for a young man with personality and sound hydraulic engineering background to be responsible for the sales and consultative service for "Ellison" Hydraulic Valves in the South of England.

The appointment offers excellent opportunities for advancement and participation in a generous non-contributory pension scheme.

Applicants must be of at least Higher National Certificate standard. Please send full particulars, including salary requirements, to :—

THE PERSONNEL MANAGER,
GEORGE ELLISON
LIMITED
PERRY BARR BIRMINGHAM 22B.
E1175 A

**IMPORTANT COVENTRY ENGINEERING FIRM,** Tile Hill area, have vacancies for :

**SENIOR DRAUGHTSMEN**

for preparing Tool Layouts and Designing special attachments for Multi-Spindle Automatics. Apprenticeship or workshop experience essential. Higher National Certificate preferred. Interesting work, giving experience of the very latest high production automatic lathes. Applications, with full particulars of age, qualifications and experience.—BOX No. E8152, "The Engineer." A

**INDUSTRIAL MODEL MAKERS**

Applications are invited by the Engineering and Construction Office of a major heavy chemical manufacturing company, situated in London, from experienced model makers, to undertake the construction of engineering design models of chemical plants.

Applicants should have a background of drawing-office experience, preferably on pipe-work, design and should have some knowledge of the techniques of design model engineering.

The company operates a pension scheme. —Applications will be treated in strictest confidence, and should give details of previous experience, qualifications and salary required, &c., to BOX E.415, c/o 191, Gresham House, E.C.2. E8135 A

**MACHINE SHOP SUPERINTENDENT** required by large British-owned Electrical Engineering Company's manufacturing plant in India. Applicants should be between ages of 30 and 40 years and have served a machine shop craft apprenticeship with subsequent experience in machining medium-sized products on batch production. Applicants should have risen to foreman or potential foreman status and be able to demonstrate machine tools and train labour. Experience of blanking presses, electroplating and light non-ferrous casting desirable but not essential. The appointment is a senior one, would be for 3 years in the first instance, with passage accommodation, medical expenses for self and family provided free. The gross salary before tax would be in the range of 1800 and 2250 rupees per month, depending on age and experience. The appointment is pensionable.—Full details should be sent to the Secretary, A.E.I. Overseas, Ltd., Crown House, Aldwych, London, W.C.2. E1153 A

**MECHANICAL AND ELECTRICAL ENGINEERING DESIGNERS AND DRAUGHTSMEN**

required by

**BRITISH OXYGEN WIMPEY LIMITED**

for their offices in Westminster.
Preference will be given to men with chemical plant layout or piping experience.
5-day week. Pension scheme.
Appointments can be arranged during working hours or in the evening.
Apply with details of age, experience, &c., to :—
The Office Manager,
BRITISH OXYGEN WIMPEY LIMITED,
17, Monck Street, London, S.W.1.
E8117 A

**MECHANICAL DESIGNER** sought by established manufacturer in London, with world market for special purpose precision machinery. Exceptional prospects for Qualified Mechanical Engineer having practical experience, aged 30–40, who is possessed of the "creative spark." Only applicant fertile in ideas, with original and inventive mind and receiving recognition in his present post on this account, need apply.

Write in confidence : Personnel Manager, Molins Machine Co., Ltd., Evelyn Street, London, S.E.8. E8113 A

**MONSANTO CHEMICALS, LIMITED,** London, have vacancies for DRAUGHTSMEN having experience of instrumentation work in the chemical manufacturing or oil refining industries. Applicants should have or be working for the H.N.C. in Mechanical or Electrical Engineering, and be able to work on own initiative and in co-operation with design engineers. The posts, which offer scope for advancement, are permanent and pensionable, and good salaries according to experience are offered. Five-day week and staff restaurant are in operation.—Applications in writing, giving full details of age, training and experience, should be sent to the Chief Personnel Officer, Monsanto Chemicals, Limited, Monsanto House, 10–18, Victoria Street, London, S.W.1. E8172 A

**MOXEY, LIMITED,** have vacancies for PROJECT ENGINEERING DRAUGHTSMEN in their Birmingham office, bulk handling or good structural experience essential Bonus and pension schemes and canteen facilities.—Apply, 13, Augustus Road, Edgbaston, Birmingham, 15. E1166 A

**POSITION OF PRODUCTION ENGINEER** is shortly to be created. Main duty includes Time and Motion Study of all Factory Operation. Applicants must have some years' experience of similar work.—Write in confidence to Chairman, Wrights Biscuits, Ltd., South Shields, with full details of past experience and present earnings. E8125 A

**PRODUCTION MANAGER**

Venesta Limited require a Production Manager for their aluminium foil factory in East London. Applicants should be between 30–40 years of age, be Associate Members of the Institution of Mechanical Engineers or Production Engineers, or hold an equivalent qualification. Previous experience as a Production Manager in a batch production factory is essential. Experience of the flexible packaging industry is desirable. The starting salary will be between £1200–£1500 per annum.

Applications, which should state age and include full details of qualifications and experience, should be addressed to the Personnel Manager, Venesta Limited, North Woolwich Road, Silvertown, E.16. E8102 A

**PROJECT ENGINEER.**—Opportunity for live young man (25–35) with H.N.C. or equivalent qualifications to join expanding engineering concern shortly opening new factory in Berkshire. Must be capable of following through development of new projects. Some experience of quantity production desirable. Write Personnel Manager.—BOX No. E8168, "The Engineer." A

**PROJECT ENGINEERS (ELECTRONIC AND MECHANICAL, INCLUDING INDUSTRIAL PHYSICISTS)**

Nash and Thompson require a Senior and Junior Project Engineer for electronic instrument development, also a Senior and Junior Engineer experienced in development of precision mechanical and hydraulic units.

We are sure that the wide and varied range of work in our laboratories will be of absorbing interest to the enthusiast in an organisation not large enough to cause frustration.

Apply, giving complete details of education, experience and salary required, to the Director and General Manager, Nash and Thompson, Ltd., Oakcroft Road, Chessington (off Kingston By-Pass), Surrey. E8056 A

**REED PAPER GROUP**

have a number of vacancies for

ENGINEERS,
PHYSICISTS and
CHEMICAL ENGINEERS

To undertake research and study development problems on heat transfer and drying. This forms a very important unit operation in the paper industry and can provide considerable scope for interesting and rewarding work. The work is varied and includes a number of physical and engineering problems concerned with increasing production efficiency. An Honours Degree or professional qualifications are required. A good salary is offered with excellent conditions of service, which include non-contributory and house purchase schemes.

These are vacancies both for newly qualified graduates and for men with some years' industrial experience.—Applications, stating age, salary and full details of experience, should be sent to the Personnel Officer, Group Personnel Division, Messrs. Albert E. Reed and Co., Ltd., Aylesford Paper Mills, Larkfield, Nr. Maidstone, Kent, quoting ref. EPCE/66. E8173 A

**RICHARDSONS, WESTGARTH (HARTLEPOOL) LTD.**
have a vacancy at Hartlepool for :
**COMMISSIONING ENGINEER**
for large size
GAS TURBINE POWER GENERATING PLANT.

The post is permanent and will carry a good salary, commensurate with the qualifications and experience of the successful applicant.

There are pension and life assurance schemes in operation.

Applications, which will be treated in strict confidence, should be addressed to the Group Personnel Officer, Richardsons Westgarth and Co., Ltd., P.O. Box 2, Wallsend, Northumberland. E8156 A

**SENIOR DESIGN DRAUGHTSMAN**

required for preparing tooling layouts and tool drawings for Multi-Spindle Automatics. Must be capable of working on own initiative and to be responsible for a new Auto Development Design Department. Coventry area. Applications, with full particulars.—BOX No. E8153, "The Engineer." A

**PROMISING PROSPECTS** for ENGINEER-JOURNALIST in a senior editorial post on McGraw-Hill's "Metalworking Production." Degree, or equivalent, and works experience desirable.—Write in confidence or telephone to Editor, 95, Farringdon Street, E.C.4. Central 0911. E8093 A

**SALES ENGINEER** required to increase sales of heat exchange equipment in the industrial and chemical engineering fields. Applicants must be of H.N.C. standard and have a keen interest in heat exchange problems. New town housing available, full range of amenities including pension scheme.—Replies, giving age, full details of previous experience and present salary level, to Personnel Officer (ref.: H.E.), The A.P.V. Co., Ltd., Crawley, Sussex. E8099 A

**SENIOR MECHANICAL DESIGN DRAUGHTSMEN** are invited to join a progressive design team engaged on varied and interesting work in the compressed air industry.—Write, or 'phone, details of experience, salary required, &c., to the Chief Draughtsman, Air Pumps, Ltd., Bushey Road, London, S.W.20 (WIMbledon 9441). E7929 A

**SENIOR PLANT ENGINEER** aged 35/45 (A.M.I.Chem.E., or A.M.I.Mech.E.) for interesting progressive position at large Chemical Works in Stratford, E.15.—Write full details age, qualifications, experience and salary desired, to Staff Manager (Ref. S.), F. W. Berk and Co., Ltd., Commonwealth House, 1–19, New Oxford Street, W.C.1. E8017 A

**SENIOR PROJECT AND PROJECT ENGINEERS**

Applications are invited from qualified Mechanical or Chemical Engineers for important new posts with

BRITISH OXYGEN ENGINEERING LIMITED.

These posts involve responsibility for the planning and co-ordination of large-scale chemical plant and other engineering projects from the initial design stages to construction and commissioning. Some previous experience in this field and the capacity for organisation and administration is necessary.

These appointments offer good prospects and excellent conditions of service, including assistance with housing where appropriate.

Applications, giving full details of age, experience, qualifications and salary required, to :—

Staff Officer,
British Oxygen Engineering Limited,
Angel Road, Edmonton, N.18.

Telephone No. EDMonton 3020.
E8142 A

**SENIOR SALES ENGINEER,** based on London, required immediately. Main requirements are broad engineering background, knowledge of European conditions and fluent French. Age 35–45.—Apply the Head Wrightson Export Company Limited, 20 Buckingham Gate, London, S.W.1. E8140 A

**SENIOR TECHNICAL SALES ENGINEERS** required, to introduce and sell fluid power transmission equipment to those manufacturers who make and want the best. Applicants should have Matriculation standard, have good engineering background, possess intimate knowledge of mechanical processes combined with electrical drives and transmissions, age approx. 40. Give full details of education, qualifications and experience, stating branch of industries and firms concerned, present salary.—BOX No. E1167, "The Engineer." A

**SMITHS MOTOR ACCESSORIES, LTD.**

require

SENIOR DRAUGHTSMAN—for Production Drawing-Office, with experience of instruments or small mechanisms, at least O.N.C. standard. Knowledge of press work an advantage.
DRAUGHTSMAN—Checker, over 30. Preferably used to instrument or precision work.
PRESS TOOL DESIGNER—with some Machine Shop and Tool Room experience.
PLANT LAYOUT DRAUGHTSMAN—O.N.C. or equivalent, with experience of minor building alterations. Layout of Machine Tools.
QUALITY CONTROL ASSISTANT ENGINEER—O.N.C. (Mech.). Experience of instruments or small mechanisms. To ascertain causes of developed faults.
METHODS ENGINEER—sound mechanical background with some knowledge of assembly procedure and layout.
TECHNICAL CLERK—some engineering background, be able to read engineering drawings and write good English.
GRADUATE MECHANICAL ENGINEER—apprenticeship or practical experience, drawing-office and design experience and at least five years' development experience with light precision engineering.
SUPERVISION ENGINEER—O.N.C. in Electrical or Mechanical Engineering. To supervise production of electro/mechanical instruments to their respective specifications.
STANDARDS ASSISTANT—preferably young man studying for O.N.C. to handle costing and standardisation of proprietary components for light engineering, allied to purchasing.
Apply to Mr. D. H. Squire, Cricklewood Works, N.W.2.
GLA 3333. E8164 A

**SIMON-CARVES LIMITED** require an OPERATING ENGINEER with experience on high pressure water tube boilers. Applicants must be prepared to travel anywhere in the U.K. Salary and conditions commensurate with experience and qualifications. Pension scheme.—Apply, giving full details and quoting Reference OP.15, to Simon-Carves Limited, Contract Labour Division, Cheadle Heath, Stockport. E8136

## SITUATIONS VACANT

**SUB-CONTRACTS MANAGER** required by rapidly expanding firm on North East Coast, to arrange for sub-contracting of substantial proportion of its output. Applicants should be keen commercial men with engineering background and a flair for detail, able to handle a large variety of items and possess ability to ensure exact performance of contracts placed. The post is pensionable and a good salary will be paid to successful applicant. Reply, giving details of age, experience and salaries earned.—BOX No. E8118, "The Engineer." A

**TECHNICAL AND COMMERCIAL EXECUTIVE** required to train for higher management. Old-established firm of mechanical engineers require a Graduate Engineer to be trained for higher management. Applicants should be between 25 and 30 years of age and resident in the London area. Previous experience in steam engineering is essential and preference will be given to applicants with knowledge of the petro-chemical industry. Training will be given in London and in branch establishments. There is a first-class pension scheme. The position will carry a generous commencing salary with prospects for advancement to the highest level. Particulars of education, technical and commercial experience should be sent in confidence.—BOX No. E1185, "The Engineer." A

**THE CHESTERFIELD TUBE COMPANY** wish to appoint a CHIEF DESIGNER to manage their Development Drawing-Office, having a staff of about seventeen. Applicants who should have experience in medium to heavy mechanical engineering, will find ample scope for initiative and imagination in the development of special plant of a highly mechanised type. A substantial salary will be paid to the right man. Permanent position, five-day week, pension scheme and canteen facilities.—Apply, stating age, details of past experience and salary required, to Personnel and Welfare Department, Derby Road, Chesterfield. E8007 A

**THE DISTILLERS COMPANY LIMITED**

The company has a vacancy at the South Wales factory of its subsidiary, British Resin Products Limited, for a technically qualified man to occupy a responsible position in a laboratory being established to provide Technical Service for a new thermoplastic material. The factory is situated in pleasant semi-rural surroundings near Cardiff. Applicants should be aged between 25 and 35, and should preferably hold a Degree, or equivalent qualification, in Chemistry, Physics or Engineering; good experience of the plastics industry is essential, whilst experience of plastics fabricating equipment (e.g. injection machines, extruders) is desirable. Salary according to qualifications and experience. Non-contributory pension scheme.—Write: Staff Manager, The Distillers Company Limited, 21, St. James's Square, London, S.W.1. Quote Ref. 45/57. E8014 A

**TECHNICAL REPRESENTATIVE** required for London office by manufacturer of firebricks and special refractories. Applicants should be 25–30 years old, preferably with some technical or practical experience in manufacture or sale of refractories.—Write in first instance for application form to E. J. and J. Pearson, Ltd., Firebrick Works, Stourbridge, Worcs. E1180 A

**TECHNICAL WRITER** required by rapidly expanding engineering company of international repute in Luton, Beds, for sales promotion duties concerned primarily with the preparation of publications ranging from technical data sheets to brochures. The job offers considerable interest and scope for initiative, since the subjects cover all branches of engineering. Applicants should have good general engineering experience and preferably hold H.N.C. Ability to write good English essential. Apply, giving full particulars.—BOX No. E7940, "The Engineer." A

**THE DISTILLERS COMPANY LIMITED DESIGNER/DRAUGHTSMAN**

The Distillers Company Limited have a vacancy at the London offices of the Engineering Division for a Designer/Draughtsman, aged between 25 and 35, to be engaged on the development and installation of instrumentation and automatic controls at the company's chemical and plastics manufacturing centres in the United Kingdom. Applicants should hold H.N.C., or its equivalent, and should preferably have previous experience of this type of work. Salary according to qualifications and experience. Non-contributory pension scheme.
Write: Staff Manager, The Distillers Company Limited, 21, St. James's Square, London, S.W.1. Quote Ref. No. 49/57. E8131 A

**THE DISTILLERS COMPANY LIMITED DESIGN ENGINEERS**

The Distillers Company Limited have several vacancies at the London offices of the Engineering Division for Civil Design Engineers, aged between 25 and 35. Duties will cover design work in connection with civil engineering projects at the company's manufacturing centres in the United Kingdom. Applicants should hold O.N.C. or H.N.C. (Civil), and should desirably have experience of this type of work within the chemical industry. Salary according to qualifications and experience. Non-contributory pension scheme.—Write: Staff Manager, The Distillers Company Limited, 21, St. James's Square, London, S.W.1. Quote Ref. No. 48/57. E8132 A

**THE DISTILLERS COMPANY LIMITED ENGINEERS**

The Distillers Company Limited have several vacancies for Civil and Structural Engineers, aged between 25 and 35, to be based in the London offices of the Engineering Division. Duties will involve design and site supervision of civil and structural engineering work at the company's manufacturing centres in the United Kingdom, and will include liaison with contractors. Applicants should hold A.M.I.C.E., A.M.I.Struct.E., or an equivalent qualification, as appropriate, and should desirably have experience of this type of work within the chemical industry. Salary according to qualifications and experience. Non-contributory pension scheme.
Write: Staff Manager, The Distillers Company Limited, 21, St. James's Square, London, S.W.1. Quote Ref. No. 47/57. E8133 A

**THE RESEARCH LABORATORIES OF THE GENERAL ELECTRIC CO., LTD., NORTH WEMBLEY, MIDDLESEX,** invite applications from Graduates, preferably with good Honours Degrees, to fill the following vacancies:—

(a) PHYSICIST or ELECTRICAL ENGINEER to work on new types of Telecommunications Line Systems. This could involve the application of transistors and the use of new techniques in the design of such systems.
(b) PHYSICIST or ELECTRICAL ENGINEER for work on the development of Quartz Oscillator Crystal Test Equipment and Circuits, particularly in the range 50–300 Mc/s. Applicants must have had at least 2 to 3 years' practical electronic experience on V.H.F. circuits.
(c) PHYSICISTS or ELECTRICAL ENGINEERS to assist with a programme of work on the development of Digital Computers. Some previous experience on pulse circuits, using transistors, is desirable.
(d) ELECTRICAL and MECHANICAL ENGINEERS to work in the fields of Industrial and High Frequency Heating.

These posts offer excellent opportunities of advancement to men with the necessary qualifications and experience.
Please apply in writing, giving full particulars, to the Staff Manager (Ref. RLO/151). E8120 A

**THERMAL AND ACOUSTIC INSULATION**

Leading manufacturers and contractors invite application from PHYSICISTS and TECHNICIANS for their Technical Division, which deals with theoretical and practical problems arising in the use of insulation both for industrial and marine purposes. Experience in the industry is desirable but not essential.

(1) Graduates in Engineering or Physics to initiate theoretical and experimental work on new problems.
(2) Technical Officers holding H.N.C. or similar qualification.
(3) Assistant Technical Officers holding O.N.C. or similar qualification for calculations and experimental work.
(4) Technical Writer with sound theoretical background for duties concerned primarily with the preparation and production of technical literature, specifications, data sheets, &c.
(5) Draughtsmen with general engineering experience for work in connection with the application of thermal insulation materials.

Superannuation scheme. Excellent working conditions in laboratories with modern equipment. Good prospects.—Write for application form to Technical Manager.—BOX No. E1181, "The Engineer." A

**WELL-KNOWN COVENTRY ENGINEERING FIRM**
require:—
**SENIOR DRAUGHTSMAN**
with experience of Machine Tool Design. Higher National Certificate standard preferred. Applications, with full particulars.—BOX No. E8151, "The Engineer." A

**TRANSFORMER DEPT. SUPERINTENDENT** required by large British-owned Electrical Engineering Company's manufacturing plant in India. Applicants should be between the ages of 30 and 40 years and have served an electrical engineering craft apprenticeship with subsequent experience of all aspects of the manufacture of distribution and power transformers in the range of 50kVA. to 2500kVA. and up to 33kV. Applicants must be thoroughly conversant with modern methods and have reached at least the position of foreman on similar work, and be able to demonstrate and train labour. The appointment is a senior one, would be for 3 years in the first instance, with passage accommodation, medical expenses for self and family provided free. The gross salary before tax would be in the range of 1800 to 2250 rupees per month, including cost-of-living allowance, depending on age and experience. The appointment is pensionable.—Full details should be sent to the Secretary, A.E.I. Overseas, Ltd., Crown House, Aldwych, London, W.C.2. E1154 A

**WELDING ENGINEERS** required in London office for preparation of welding procedure specifications for alloy materials, and for liaison with drawing and design offices and sub-contractors on welding problems. Also for works at Egham, Surrey, to revise procedure specifications in accordance with actual welding practice and procedure tests, and to assist in development of new welding techniques and application of new welding machines. Experience of Class I welding of heavy pressure vessels or high pressure pipework is essential. Technical qualifications Higher National Certificate or equivalent.—Write stating age and experience: Foster Wheeler, Limited, 3, Ixworth Place, S.W.3. E8030 A

**WELL QUALIFIED** young ENGINEER, trained in electrical engineering or electronics, required by large firm of chartered patent agents in Northern England. Excellent prospects. State present salary and details of training.—BOX No. E1164, "The Engineer." A

**WORKS MANAGER** required for Fabricating Works in South Midlands. Duties cover all production, planning and estimating, including small machine shop.—BOX No. E8122, "The Engineer." A

**YOUNG ENGINEERS** required for technical work in large light engineering firm in Mid-Essex. Qualifications should include H.N.C. (Mechanical) or equivalent and practical engineering training. Working conditions are good, there are excellent prospects, and salary will be according to experience. Please apply giving full details of training, practical experience, previous and present positions and age.—BOX No. E8095, "The Engineer." A

**FREE PISTON ENGINES**

ALAN MUNTZ AND CO., LTD., Research and Development Engineers, Browells Lane, FELTHAM, Middx., have a vacancy for a DEVELOPMENT ENGINEER with a Degree or H.N.C. in Mechanical Engineering. Age up to 33 years. The work relates to the development of Free Piston Gas-Generator/Gas Turbine prime movers and associated gear and Free Piston Air Compressors. Usual holidays and pension scheme. —Apply in writing to The Chief Engineer. (All applications will be treated in confidence). E8085 A

**PAMETRADA RESEARCH STATION, WALLSEND**
requires a
**DEPUTY DIRECTOR (DESIGN)**

The position is a very highly responsible one and offers very real scope for the development of marine turbine designs. Applicants should have a University Degree in Mechanical Engineering and have had wide experience in the design and manufacture of steam turbines operating under high inlet conditions, and also have held a responsible Design Office position. A knowledge of gas turbine design and construction is an additional advantage. Applicants should be aged between 35 and 45, although some departure at the upper end of the scale will be considered if all other requirements are satisfactory. The position is permanent and pensionable. The salary offered will be in the region of £3500 according to qualifications. —Applicants should send full particulars of qualifications, experience, &c., to the Director, Pametrada Research Station, Wallsend Northumberland. Replies will be treated in the strictest confidence. E7922 A

**SENIOR DRAUGHTSMAN**

required, experienced in heavy machinery plant layout and material handling; first-class man only.

This is an opportunity to join small team in large organisation, offering regular employment with good salary, pension fund and profit-sharing bonus.

Reply, giving full particulars of experience, age, &c., to

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**THE ASSOCIATED PORTLAND CEMENT MANUFACTURERS LTD.,**
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E7855 A

Classified Advts. continued on page 8

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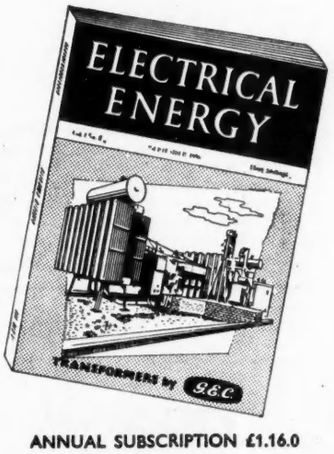


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Excellent opportunities, in the Automobile field, to join a small team engaged on Design/Development of a rapidly expanding Product of this Company.

The work is both interesting and remunerative ; all posts are fully superannuated.

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All replies will be treated in strictest confidence.

Write for the attention of the :
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Mechanical Engineer, with overall experience of Steelworks Plant who wishes to save 50 per cent of his salary over the next three years, is required to supervise the erection and commissioning of a large integrated Steel Plant being erected in India. Conditions of employment are good and the location is healthy. Good salary and allowances are paid to an experienced man, who should be over 35 years of age.—Applications, stating age, education, experience and whether married or single, should be made to BOX No. E8036, " The Engineer." A

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LONDON, N.18
Tel: EDM 3020

E85 A

NUCLEAR POWER STATIONS

## PRESSURE VESSEL ENGINEERS & DRAUGHTSMEN

Applications are invited for the following appointments in the ATOMIC ENERGY DIVISION of

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**(1) PRESSURE VESSEL ENGINEERS**

Applicants should have design experience on pressure vessels for the refinery or chemical industries and should be conversant with the various codes of practice. Shop fabrication or site erection experience would be an advantage. Minimum qualifications H.N.C.

Duties would include the development of designs, from initial concept to fabrication stage, of the numerous pressure vessels which are required in this field for power stations and research projects. Some of these vessels are the largest and most complex of their kind and require the careful solution of many novel problems.

**(2) SENIOR DRAUGHTSMEN**

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**(3) JUNIOR DRAUGHTSMEN**

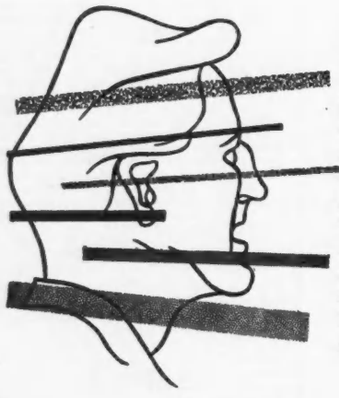
Applicants who do not possess the experience required for posts in (1) and (2), yet who are interested in this field, will be considered for positions as Junior Draughtsmen. In the absence of other qualifications they should be studying for at least O.N.C.

All the above posts provide opportunities for advancement in a rapidly expanding industry, and attractive salaries will be offered to suitable applicants.

Appointments for interview may be made by telephone and interviews can be arranged in London, Manchester, Newcastle or Glasgow. Housing assistance can be given to suitable applicants and removal expenses will be paid. Holiday arrangements already made will be honoured. Written applications should be sent to the Personnel Manager (P.V.), The General Electric Company, Limited, Erith, Kent. Telephone, Erith 3011 ; Extension 45.

E8026 A

## what's *your* line?



If you are a draughtsman and your experience lies in building construction, structural engineering, electrics, heating and ventilating, chemical, refinery or other process plant, your experience and ambition would find their outlets with Coniston. The Company handles installations in the above fields, from planning to production. If you are looking for opportunities why not write to

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*PHONE WIMBLEDON 8521*

P.4388

E42 A

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Applications are invited from Mechanical Draughtsmen who are contemplating emigrating to Canada and who possess the following qualifications :—

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## SITUATIONS VACANT

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*Applications will be treated as confidential and should be made, giving details of age, qualifications, experience and salary required to:—Manager/Personnel*

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**CORBY · NORTHANTS**

E83 A

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Applications are invited from men with good experience in architectural and civil engineering work related to the design and construction of new industrial premises.

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E84 A

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## STRUCTURAL DESIGN ENGINEERS
AND
## DESIGN DRAUGHTSMEN

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E8011 A

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A

## SITUATIONS WANTED

**CHIEF ENGINEER,** A.M.I.Mech.E. (39). Present position 6 years. Responsible for all development, design and production on woodworking and building engineering machines and general sub-contract work. Present salary £1200. Seeks appointment as General or Works Manager or similar.—BOX No. E1169, "The Engineer." B

**G.I.MECH.E.,** aged 29, seeks Overseas Post, preferably involving travel. Experience embraces technical liaison, aircraft and general mechanical engineering design, production and progressing. Interested irrigation, structures or sales/service, but anything considered.—BOX No. E1186, "The Engineer." B

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## PATENTS

**THE PROPRIETOR** of British Patents Nos. 711,298, 711,299, 709,958, entitled "IMPROVED PLUG CLOSURES FOR HANDHOLES AND THE LIKE OF PRESSURE VESSELS," "A GATE VALVE WITH AN IMPROVED BONNET AND SEALING MEANS THEREFOR," and "IMPROVED PLUG CLOSURES FOR HAND AND LIKE HOLES IN PRESSURE VESSELS," offers same for Licence or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern and Carlberg, 14, E. Jackson Boulevard, Chicago, 4, Illinois, U.S.A. E8027 H

**THE PROPRIETOR** of British Patent No. 709,306, entitled "WELL PACKERS," offers same for Licence or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern and Carlberg, 14, E. Jackson Boulevard, Chicago, 4, Illinois, U.S.A. E8139 H

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Guillotine to shear mild steel plates 6ft. wide by ¾in. thick.—BOX No. E8146, "The Engineer." F

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# 600

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Quantity of 24kW. and 15kW. Compound Wound, 100-volt D.C. Generators, by L.D.C., E.C.C., and E.E.C., drip-proof frames with endshield ball/roller bearings, various speeds between 1440 and 1625 r.p.m.

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Designed for 190-ton on 58ft. span, 72ft. lift, by Sir Wm. Arrol and Co., Ltd., now arranged for 106ft. span, capacity 90 tons. Can be altered to any intermediate span with equivalent lifting capacity. Weight 334 tons.

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**DRILLING, BORING AND TAPPING MACHINE**

ASQUITH 8ft. RADIAL ARM DRILLING, BORING and TAPPING MACHINE : spindle No. 5 morse taper ; elevating arm ; low base with loose box table.

F. J. EDWARDS, LTD.,
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**GENERATING SETS**

Westinghouse Generating Set, 31kVA. 115/230 volts, trailer type, Cummins diesel engine.

CHAMBERLAIN INDUSTRIES, LIMITED
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**URQUART** 6in. by 7ft. S.S. and S.C. Lathe, £20 ; and Torpex 18in. Crank Shaping Machine, £50 ; both complete but require attention.—Woodhill, Hatfield, Herts. E1182 G

**Classified Advts. continued on page 10**

FOR SALE

## CRANES

Neals "Rapid" Type "G" Cranes, 15 cwts. capacity, petrol.
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CHAMBERLAIN INDUSTRIES, LIMITED
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Tel.: LEYtonstone 3678. E8109 G

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DIMCO

## NEW HORIZONTAL AND VERTICAL BORERS

UNION 2½in., Model BFT.63, Horizontal Boring and Facing Machine, table type.
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NILES 52in., Single Column Vertical Boring and Turning Mill, Model DKES 1320.
NILES 6ft. 6in., Double Column Vertical Boring and Turning Mill, Model DKZ 2000 × 1250.
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415-417, OXFORD STREET,
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## HYDRAULIC PRESSES

10,000-ton Hydraulic Forging Press, Pumps and Accumulator (Unused).
4000-ton Hydraulic Bending Press, upstroke, table 18ft. 6in. by 10ft., with Pumps and Accumulator (Unused).
2650-ton Hydraulic Rubber Sheeting or Belting Press, platens 18ft. 4in. by 7ft. 4in., with Pump Unit.
2000-ton Hydraulic Forging Press by Wagner, 5ft. stroke, 11ft. daylight, bed 8ft. 6in. by 8ft.
2000-ton Upsetting Press by Loewy, Horizontal and Vertical Rams, 27in. dia.
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1400-ton Downstroke Forging Press by Tangye, bed 7ft. square.
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Many other smaller Presses.

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Tel.: Woolwich 7611 (6 lines). E7801 G

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6-ton Ransomes & Rapier Super (slewing type) Petrol or Diesel/Electric Mobile Crane on solid rubber tyres.
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5-ton Smith Steam Loco. Crane, 35ft. jib. New 1949. 4ft. 8½in. gauge.

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**NEWTON BEAN AND MITCHELL** Steam engine (1921), single-cylinder, non-condensing, 300 h.p. at 100 r.p.m., working steam pressure 60/120 lb. sq. in., complete with countershaft, girders, rope pulleys and Metro.-Vick D.C. generator, 230V, 97kW. Would separate.—Apply:

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**MODERN BAGNALL** 0-6-0 Steam Locomotive with 18in. cylinders. Tractive effort 25,000 lb.—Full details from: Abelson and Co. (Engineers, Limited, Coventry Road, Sheldon, Birmingham, 26. Telephone No.: SHEldon 2424. E7949 G

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TWW

FRASER Type OLS30 OILAULIC PUMPS, cap. 30 g.p.m. at 3500 p.s.i., each pump coupled to a 75 h.p. motor, wound suitable for 400/3/50.
HORIZONTAL THREE-THROW HYDRAULIC PUMP by BERRY, rams 2in. dia. by 6in. stroke; 2 tons p.s.i. press., approx. 13 g.p.m., 62 r.p.m. gear wheel, pinion, &c.
HORIZONTAL THREE-THROW HYDRAULIC PUMP by HUGH SMITH, 1¼in. rams, 6in. stroke; 1 ton p.s.i.; 15 h.p. slip ring motor, 400/3/50, 750 r.p.m., starter.
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THOS. W. WARD LTD.
ALBION WORKS - - SHEFFIELD
'Phone: 26311. 'Grams: "Forward" E213 G

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Mobile Compressor, Holman two-stage, 68 CFM petrol engine, two wheel trailer, £150.
Atlas Diesel Compressor, 120 c.f.m., Dorman diesel engine, four wheel chassis, £450.
400 c.f.m. Compressor, Atlantic diesel engine, pneumatic tyred trailer, unused, some spares, £650.

CHAMBERLAIN INDUSTRIES, LIMITED
STAFFA WORKS, STAFFA ROAD, LEYTON, LONDON, E.10.
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600

DIESEL ALTERNATOR SETS

Quantity 30kVA. GARDNER/MAWDSLEY self-contained Sets, engine vert., 4 cyl., 4LW radiator cooled, electric start, 1000 r.p.m., alternator 400/3/50.
Five 5·625kVA. LISTER/E.C.C. Sets, engine vert., single cyl., 9/1/35, 4 stroke, hand start, 1000 r.p.m., alternator 230/1/50.
Three Unused 5·625kVA. RUSTON/E.C.C. Sets, engine vert., twin cyl., 2VTH radiator cooled, 4 stroke, hand start, 1000 r.p.m., alternator 230/1/50.

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HYDRAULIC PUMPS

Hydraulic Accumulators, Valves, Fittings, New and Second-hand. Complete installations.
All kinds of Hydraulic Equipment in stock.

THOMPSON AND SON (MILLWALL), LTD.,
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Byers Model 75, Excavator, diesel engine, 35ft., drag-line and bucket and face shovel equipment.
N.C.H. Model 150 Excavators, diesel, 40ft. jib and drag-line bucket (reconditioned machine).

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**GAS PRODUCER PLANT,** gasification 5 tons coal per hour, comprising two MORGAN 11ft. Gas Machines complete with dust catchers, downcomers, valves, &c., twin feed hoppers with elevator, all contained in steel-framed building. Complete with all electric motor drives, controls, &c. Plant new 1944. Very low price.—BOX No. E8003, "The Engineer." G

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Edwards

RHODES Power Geared Bending Roller, bench type, belt drive, capacity 49¾in. by 16 s.w.g. mild steel, diameter of rolls 3in. Weight about 8 cwt.
ROBERTSON Gang Slitting Machine, adjustable gauges, cutters fitted 10in. by ¾in., capacity ¼in. thickness, between housings 24in. Weight 45 cwt.
SCHULER Type AAC, size No. 2, Double-Sided Geared Press, tie rod frame, motorised 440/3/50, pressure approx. 90 tons, stroke adjustable 1¼in. to 4 11/16in., between uprights 23¾in.
NEW MUBEN Bar and Angle Shear, Model KSG100, all-steel build, motorised 400/3/50, complete with blades for flat bars, rounds and squares; capacity: rounds 2in., squares 2in., flat bars 10in. by ¾in., angles up to 4in. by ½in., other sections in proportion.
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NEW BESCO Universal Swing Beam Box Forming and Folding Machine, type F, capacity 40in. by 11 s.w.g., maximum lift of beam 6in.
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Of Every Description. Attractive Prices.

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OFFER FOR IMMEDIATE SALE
HOISTS

Ant Queen Hoist, 10 cwts., 20ft. mast, diesel engine, unused.

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New 36in. bore C.I. Sluice Valve for exhaust steam or water. B.S. flanges.
New 18in. bore Dewrance C.S. Parallel Slide Valve. B.S.T. "H" flanges.

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E8127 G

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FOR SALE

Nearly new 100-ton Electric Overhead Travelling Crane, 100ft. span. Span can be reduced down to 58ft., at which the lifting capacity is 190 tons. Electric 400 volts, 3 phase, 50 cycles, 72ft. lift.

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HEAVY DUTY
**RAPIDAN GEAR GENERATOR**
LATE TYPE
FOR IMMEDIATE DELIVERY

Size No. 4 extended.
For internal and external spur gears.
Max. capacity for internal work 68in., with max. overall diameter 74in.
Max. O.D. external gear 56in.
Face width 6in.
Min. pitch 10 D.P.
Max. pitch 2 D.P.
Four cutting feeds.
Motor 7·5 H.P.
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E210 G

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**RECONDITIONED and GUARANTEED**
**JONES CRANES**

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| KL.15 | Capacity | 15 | cwts |
| KL.22 | ,, | 2 | tons |
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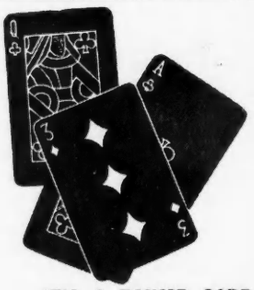

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*WARDS might have it!*
**THOS. W. WARD LTD**
**ALBION WORKS, SHEFFIELD**

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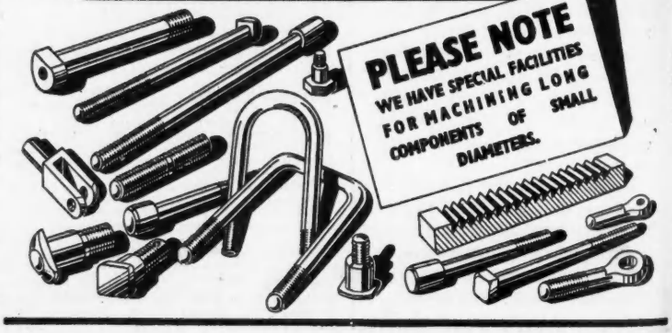
THE PLATT, PUTNEY, S.W.15
'PHONE: PUTNEY 7121
'GRAMS: COSSENTINE, PUT. LONDON



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***Hundreds of working hours in your Drawing Office, Workshop, Estimating Department, etc., by using***

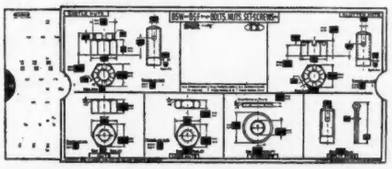
# OMARO SLIDE RULES

***Here are a few of our models :—***

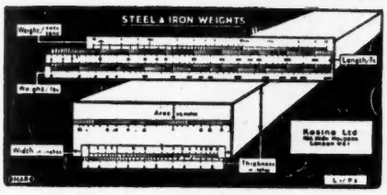
**MODEL S3. BSW/BSF Bolts and Nuts**

Full particulars of B.S.W. and B.S.F. bolts and nuts. Drill sizes for tapping and clearing. Also sizes of screw heads and square head set-screws.

5/3 post free.



**MODEL L.I. Calculation of weights of steel sections**




Multiple scales giving simultaneously

(*a*) Area of cross section.
(*b*) Weight per foot.
(*c*) Weight per length in feet (1 to 10,000 feet)
(*d*) Lengths per cwt.(s) and ton(s)

according to width and thickness. These scales can also be used for any other section if weight/foot or area are known. See our model P.I. 7/- post free.

MODEL K1/K2—SIDE 1, STEEL and IRON TUBE WEIGHT CALCULATOR and SIDE 2, PRICE CALCULATOR... ... ...*PRICE 15/6 POST FREE*

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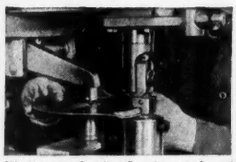

*Working with the flanging tool and circle guiding attachment.*

*Cutting inside the sheet without starting hole, freehand or with straight or circle guiding attachment.*

*Working with the preening tool, freehand, for dished parts, pans, trays, etc.*

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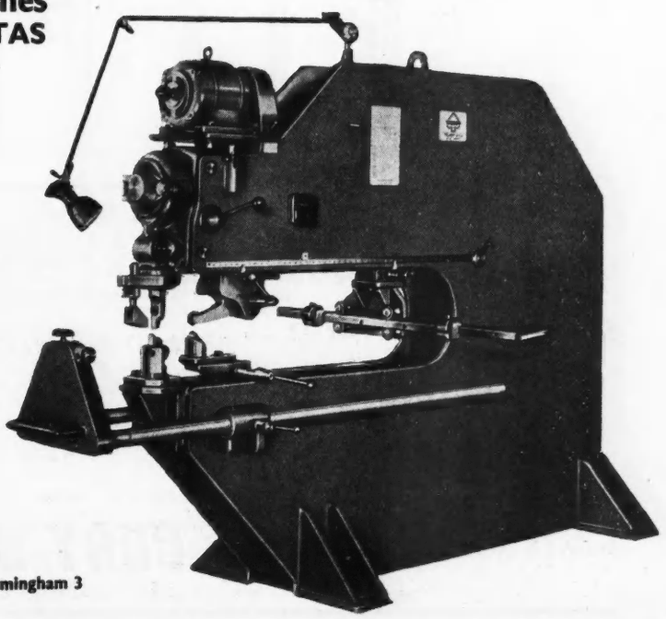
**Call at our showrooms, where a demonstration will convince you of the great value of these machines to you!**

*talking of machinery* BESCO *think of Edwards*



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A and AI

Junior

Minor (Mk II)

Micro Minor

**A. & A.I.** 3 — 15 lbs. ft. (0.41 — 2.07 m. kg.)
10 — 50 lbs. ft. (1.38 — 6.91 m. kg.)
**Junior** Up to 100 lbs. in. (115.19 cm. kg.)
**Minor (Mk II)** Up to 36 lbs in. (41.47 cm. kg.)
**Micro-Minor** Up to 36 oz. in. (2.59 cm. kg.)

**Sixteen models provide for all loads up to 850 lbs./ft.**

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## PRECISION TORQUE SPANNERS

**A.4. & A.5.** 10 — 65 lbs. ft.
(1.38 — 8.99 m. kg.)

**B.3.** 20 — 100 lbs. ft.
(2.77 — 13.82 m. kg.)

**B** 15 — 80 lbs. ft.
(2.07—11.06 m. kg.)

**A.2.** 10 — 50 lbs. ft.
(1.38— 6.91 m. kg.)

**C.1. & C.2. (calibrated)** 5—55 lbs. ft.
(0.69 — 7.60 m. kg.)
50 — 150 lbs. ft.
(6.91 — 20.73 m. kg.)

**B.3/2.** 20 — 130 lbs. ft.
(2.77 — 17.96 m. kg.)

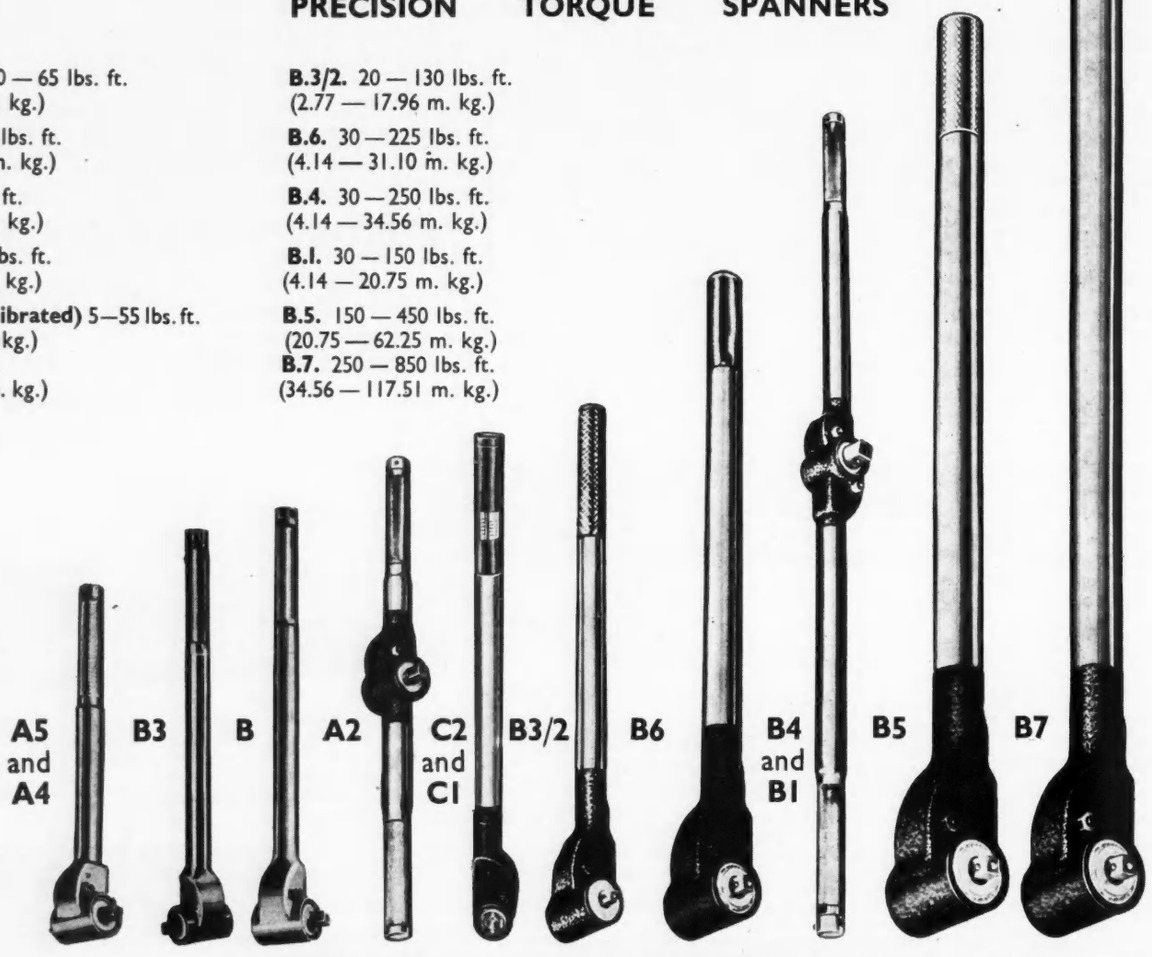
**B.6.** 30 — 225 lbs. ft.
(4.14 — 31.10 m. kg.)

**B.4.** 30 — 250 lbs. ft.
(4.14 — 34.56 m. kg.)

**B.1.** 30 — 150 lbs. ft.
(4.14 — 20.75 m. kg.)

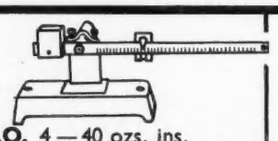
**B.5.** 150 — 450 lbs. ft.
(20.75 — 62.25 m. kg.)

**B.7.** 250 — 850 lbs. ft.
(34.56 — 117.51 m. kg.)




## UNIVERSAL TORQUE SPANNER TEST AND SETTING RIGS

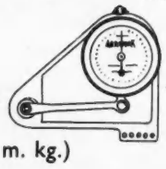
**L.4.**
0 — 1000 lbs. ft.
(0 — 138 m. kg.)



**L.O.** 4 — 40 ozs. ins.
(0.3-3.0 cm. kg.)

**L.I.**
0 — 50 lbs. ins.
(0 — 58 cm. kg.)

**L.3.** 0-400 lbs.ft. (0—55 m.kg.)



**L.2.**
0 — 200
lbs. ft.
(0 — 27 m. kg.)

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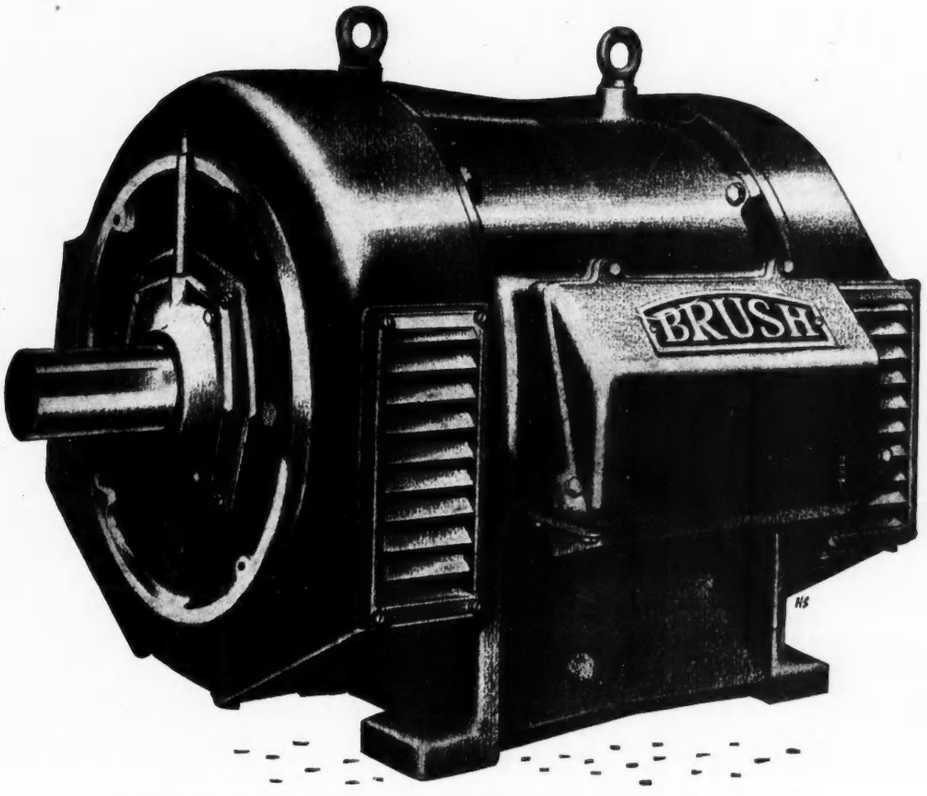
CORYS' BUILDINGS, CARDIFF Telephone : Cardiff 31141




## But-what's so special about this one?

*On the face of it, it's just another electric motor, I know, sir.*
*But you see, being a BRUSH motor makes quite a difference.*

Why? I'm afraid I can't see any difference.

*Well, I suppose it's a matter of experience. These Brush people were among the first manufacturers of electric motors and such. And this experience shows—in the workmanship of even the smallest parts, and all the thousand-and-one details of the construction.*

You mean a Brush motor is more reliable? And the firm will save money because of this?

*Oh, absolutely. We'll get the maximum work out of it with the minimum of trouble. It'll give years of service, and maintenance will always be quick and easy because everything's so accessible and, well, so meticulously tested and . . .*

All right! Say no more. I'm convinced. For once, we've done the right thing. It seems that everybody's going to be pleased the new machine is powered by Brush.

**BRUSH**

**the power people**

*Write for literature on the type of power equipment you are interested in, to:*

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## The facts say YES

Every time your packages are handled, stacked, or transported by road, rail, sea or air, they are constantly being subjected to greater and lesser degrees of shock and vibration in transit.

These typical shock hazards during transit for packaged products are worth considering:—

**SHOCKS:**

Railway—shock while shunting can produce impact velocities up to 10 feet per second with a deceleration of up to 30g.

Road Transport—rough roads can give accelerations of 2.5g. Shunting operations, sudden bumps of cross country tracks can give shocks as high as 20g.

Aircraft—occasionally due to manoeuvring or turbulent air conditions—shocks of up to 3g can occur. Landing, taxying and take-off can produce 4g. Greater shocks can be experienced during handling and loading—up to 12g.

**VIBRATION:**

Railway—beat of wheels on rail joints and similar running shocks may produce continuous vibrations in the range 2-3 c s at amplitudes up to plus or minus 1½in.

Road Transport—road surfaces may set up vibrations within the frequency range 1 - 15 c/s with acceleration of 5g as maximum.

Ships—vibrations excited by engines and propeller, electrical equipment and winches. Vibrations vary with size of ship, type of engine, etc., but generally in range 5-20 c s with amplitudes less than plus or minus 0.03 in. These conditions are likely to be maintained for long periods.

Aircraft—at centre of aircraft range, from 10-500 c.s. At lower end of frequency scale amplitudes are about plus or minus 0.008 in.

Stacking Loads—packages in warehouses or depots may be stacked as high as 20 ft. Crushing loads of one ton ft.$^2$ may be encountered during sea transport.

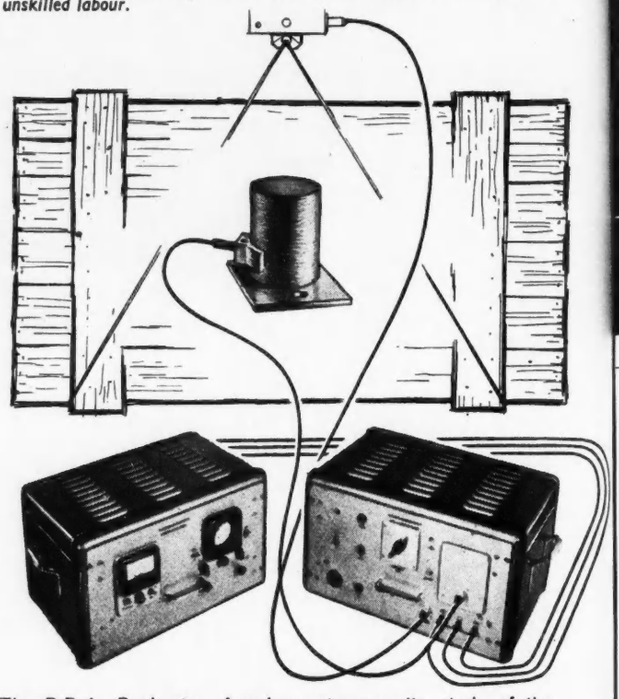
These are shocks that may be anticipated by your Packaging Department and it is now possible for them to carry out simple tests on different types of cushioned package, and in short time produce designs to ensure the safe transit of all your equipment. The device designed by B.P.A. Electronics in association with the Ministry of Supply and now available for Commercial application for the first time, is called B.P.A. Packaging Accelerometer.

**It consists of:—**

1 The Accelerometer unit itself. Basically a ceramic disc which develops a positive or negative electric charge across its face according to the shock applied to it. Cables carry this electrical current shock reaction to

2 . . . the Delay and Power Unit. Basically this unit does a double job. It provides electricity for the electro-magnetic release mechanism to drop the package and the delay section provides an electrical impulse for operating the . . .

3 Display Unit. This unit shows the impact shock on the package either on a cathode ray tube (a camera can be used in association to photograph the cathode ray tube trace), or on a peak reading meter which captures the peak 'g' giving a steady indication of shock on a 'g' scale (maximum reading 100g). The latter is particularly useful for routine checking of packaging by *unskilled labour.*



The B.P.A. Packaging Accelerometer permits study of the design for cushioned packages by measuring:—

1 deceleration and acceleration,
2 duration of shock,
3 resonant frequency.

Once the operating principles of the small, robust units have been explained, operation and package diagnosis are simplicity itself.

Write for the special brochure about this equipment.

***COMBAT THIS PROBLEM WITH THE* B.P.A. ACCELEROMETER**

BPA Electronics

BOULTON PAUL AIRCRAFT LTD · WOLVERHAMPTON ENGLAND

# Factory Buildings

We have for many years specialised in the supply and erection of Factory Buildings in the £500/£40,000 price range.

Our standard design steel-framed asbestos-sheeted Industrial Buildings are manufactured in spans from 18 feet to 50 feet, with lengths made up in 15-foot bays. Our prices are very competitive, and we guarantee to complete the erection of the largest building within 5 to 6 weeks of the date of receipt of an order.

We are also pleased to quote to Architects special requirements for both structural steelwork and roofing, glazing, windows, etc. Depending upon the steel sections involved, our deliveries are usually between 6 and 16 weeks.

Our experienced Design Staff will be pleased to deal with your enquiries.

Overseas Enquiries welcomed—we give C.I.F. quotations by return of post.

*Photograph of steelwork for a factory extension for Serck Radiators, Ltd., Birmingham—steelwork and roofing supplied and erected by R. O. Wright & Co., Ltd., Main Contractors George Wimpey & Co., Ltd.*

TELEGRAMS STEELWORK, PHONE, BANBURY

**R·O·WRIGHT·&·CO·LTD**

DEPT. E. 3. LOWER WORKS · BANBURY · OXON

TELEPHONE BANBURY 2271

# Solve Problems of Ventilation and Chemical fume extraction...with

**ONE MAN CAN CARRY UP TO 100 FT. AND INSTAL 250 FT. IN AN HOUR**

## AVAILABLE IN THREE GRADES

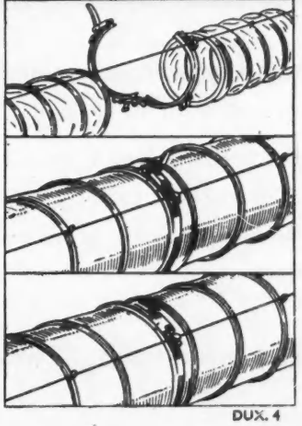
**Type 'S'**
*Stiffened with external helical wire, totally enclosed in plastic to prevent corrosion. Suitable for both positive and negative pressures.*

**Type 'B'**
*Stiffened with spaced circular rings, protected as above. For positive pressures only.*

**Type 'FL'**
*Flat sleeve with totally enclosed interlocking end rings. For positive pressures only.*

FLEXADUX REGD

Simple lever-locking device on coupling clips for quick assembly and air-tight seal.



**ABRIDGED DATA**
**Composition:** P.V.C. plastic rot-proof, age resistant and non-combustible.
**Pressure Limit:** 20" water gauge
**Tensile Strength:** 3,200 lbs/sq.in.
**Standard Diameters:** 8", 12", 16" (all types), 20", 24", (types 'S' and 'B') 28", 32", (type 'S' only).

## FLEXIBLE PLASTIC DUCTING

Tough, because its proving-ground was the coal mines of Europe, and concertina'd for economical storage, Flexadux is easily transported and quickly assembled. Tees and elbows of Flexadux are also available. *Full details from:*

**WILKINSON RUBBER LINATEX LTD**
**CAMBERLEY, SURREY. Phone: Camberley 1595**

DUX. 4

SPECIALISED

# PIPEWORK

## for Britain's Power Programme

**DRAKELOW "A" POWER STATION**

Aiton & Co. Ltd. designed, manufactured and erected the austenitic stainless steel, main steam pipework for the four unit sets each consisting of a 515,000 lb./hour boiler and a 60 M.W. turbo-alternator.

The turbine steam stop valve conditions are 1500 lbs./□" and 1050° F.

The E.H.P. steam mains are supported on Aiton "UNILOAD" constant load pipe supports in order to cater for the very large thermal movements created by the high operating temperature.

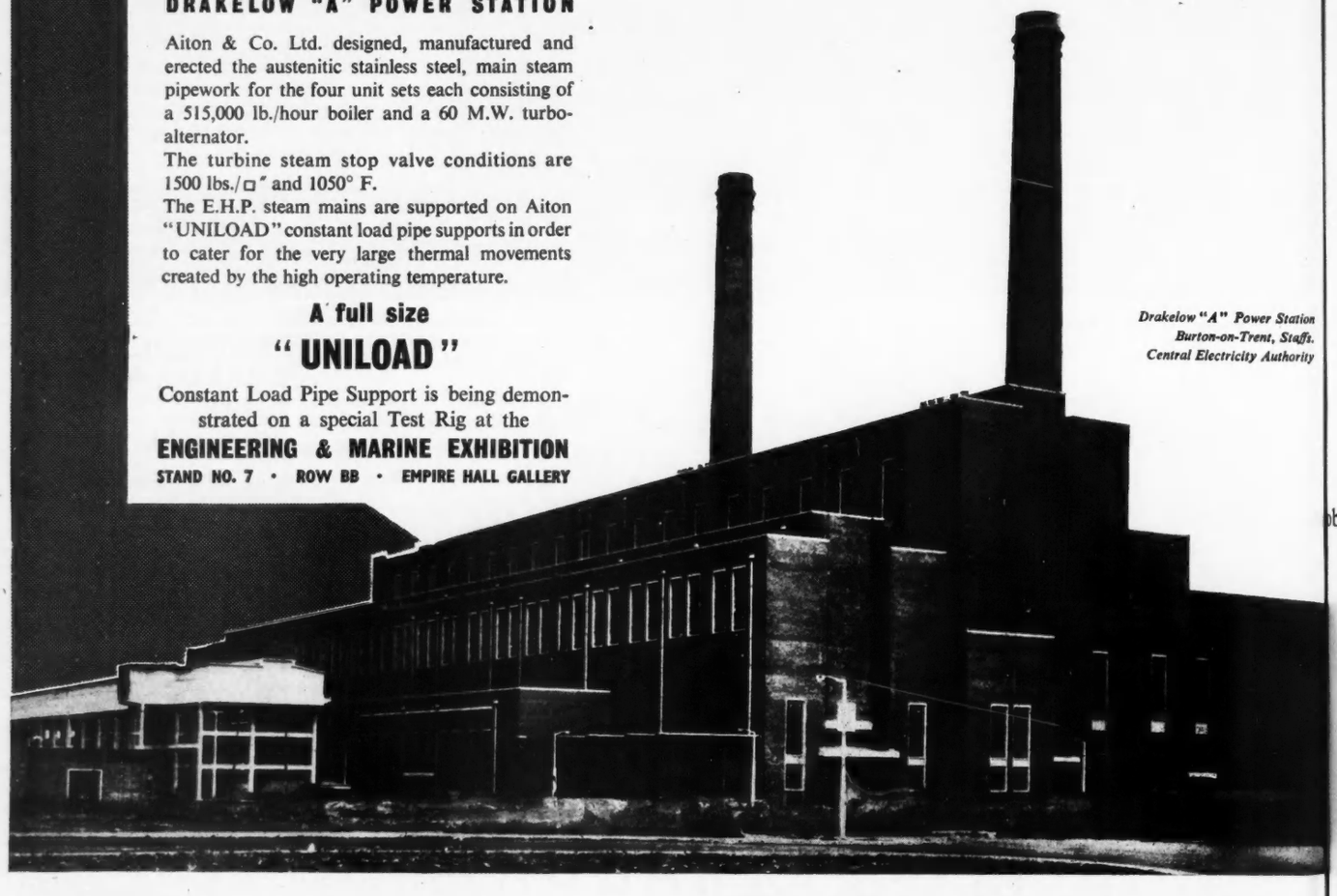
**A full size**

**"UNILOAD"**

Constant Load Pipe Support is being demonstrated on a special Test Rig at the

**ENGINEERING & MARINE EXHIBITION**

**STAND NO. 7 · ROW BB · EMPIRE HALL GALLERY**



*Drakelow "A" Power Station Burton-on-Trent, Staffs. Central Electricity Authority*

***Other important services*** in Aiton & Co.'s contracts for this great Power Station included :-

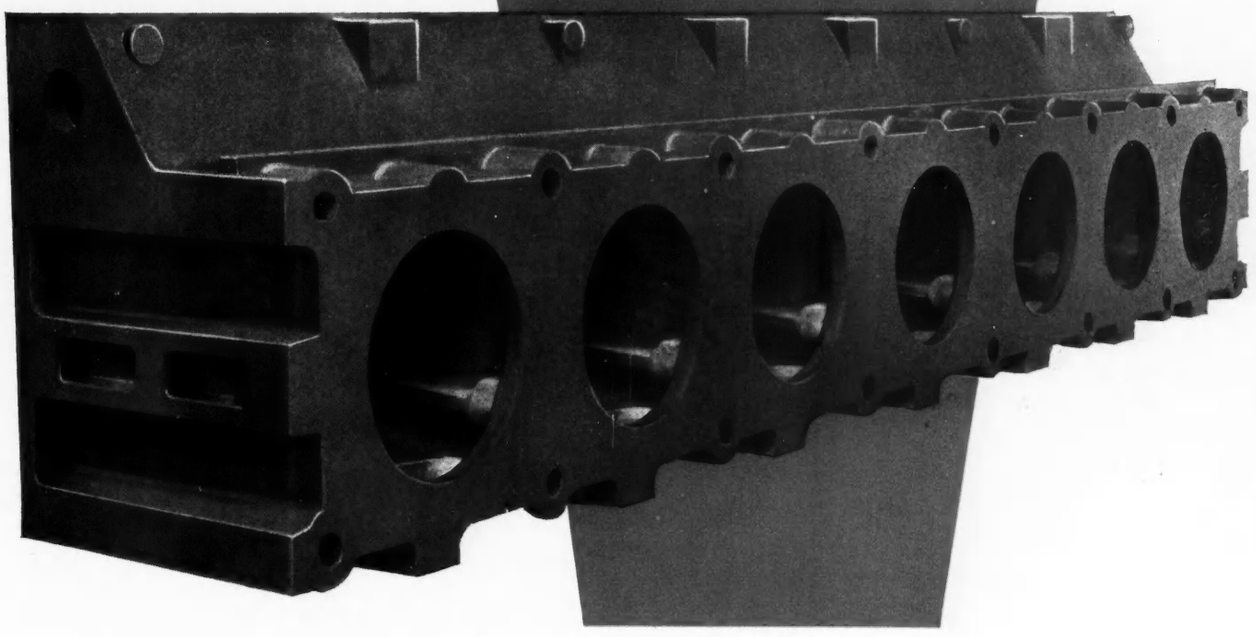
E.H.P. Feed Pipework, Boiler Integral Pipework, Turbine Integral Pipework, Main Circulating Water Pipework, etc. Distilled water for boiler make-up is provided by Aiton Evaporator-Distilling Plants.

AITON DERBY & CO. LTD.

ESTABLISHED 1900

**HEAD OFFICE · DERBY · · WORKS · DERBY & SUNDERLAND · · TELEPHONE · DERBY 44271 (6 LINES) · · TELEGRAMS · CHANNELED DER**

*cast in*
**MEEHANITE**



This 7 cylinder casing, for a power unit by Mirrlees, Bickerton & Day, must be of unvarying strength and dependability—an obvious call for Meehanite Metal. For Meehanite is unique in giving castings of uniform consistency and specified resistance to heat, wear or corrosion. Where castings of rugged strength and reliability are vital, specify Meehanite. Our foundry can supply floor and loam-moulded castings up to 20 tons.

**CONSISTENT**
***through***
***and***
***through***

**ASHMORE, BENSON, PEASE & CO.**

*A Member of the Power Gas Group*

STOCKTON-ON-TEES

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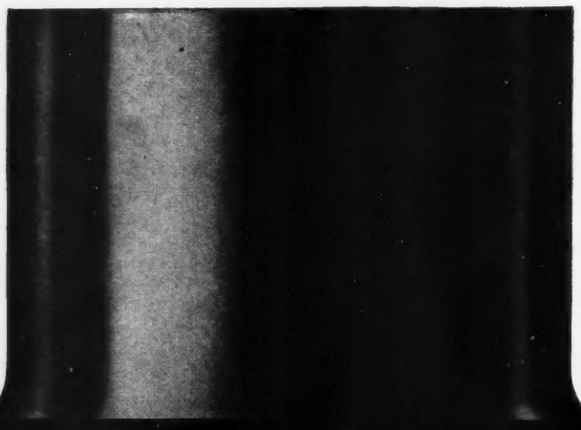
QUALITY
ASHMORES MEEHANITE
AND SERVICE

B



**ENGINEERING, MARINE AND WELDING AND NUCLEAR ENGINEERING EXHIBITION**
**AUGUST 29—SEPTEMBER 12**
**Ground Floor, Grand Hall**

We are showing typical examples from our wide range of diesel engines, which cover marine, industrial and traction requirements up to 3000 b.h.p.

# CROSSLEY DIESEL ENGINES

**STAND 12 ROW G**

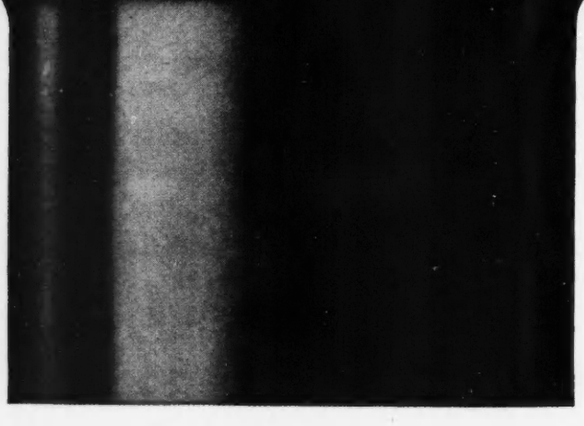
**EXP 6** 500 b.h.p. exhaust turbo-charged four-cycle diesel engine. Generating set for marine auxiliary duty.

**HST Vee 8** 1200 b.h.p. power unit for diesel-electric locomotives. 8 cylinder two-cycle diesel engine, with flange mounted Metropolitan-Vickers generator.

**CRL 6** 1100 b.h.p. marine propulsion engine. 6 cylinder two-cycle diesel engine.

**HRN 6** 800 b.h.p. marine propulsion engine. 6 cylinder two-cycle diesel engine.

# AT OLYMPIA 1957



**STAND 12 ROW H**

**ESB 6** A new general purpose high speed two-cycle diesel engine.

**ESL 5** 240 b.h.p. two-cycle Scavenge Pump Diesel generating set.

**ERL 6** Two-cycle marine propulsion engine, demonstrating Crossley remote control, and direct reversing.

CROSSLEY BROTHERS LIMITED
OPENSHAW · MANCHESTER 11

℗ C421

# RUHRSTAHL A.G.
1854 HENRICHSHÜTTE 1954
HATTINGEN-RUHR
(GERMANY)

Agents for Scotland, Newcastle-on-Tyne and Northern Ireland: A. & J. McCulloch & Miller, 180, West Regent Street, Glasgow, C.2

**Crankshaft**
**finished weight 94000 kgs**
**total length 16810 mm**
**for a heavy ships' Diesel engine**
**(Doxford engine)**

## RUHRSTAHL-CRANKSHAFTS

**up to the largest dimensions, solid forged or built-up, with Cast Steel or Forged Steel Crank Webs, for Ships' Diesel Engines of all types**

We further supply:

Connecting and Piston Rods, Pistons, Crossheads etc. Centrifugally cast iron highly wear-resisting Cylinder Liners up to the largest dimensions • Starting Air Tanks and Exhaust Mufflers Housings and Foundation Plates in cast steel and welded construction • Complete Line Shaftings, Ruddershafts and Stern Frames

*LINCOLN ELECTRIC SERVES THE INDUSTRY OF THE WORLD*

# Thames Haven to Romford Pipeline

In constructing this 17-mile 24-inch welded steel pipeline for the North Thames Gas Board and Shell-Mex and B.P. Ltd., Messrs. William Press & Son Ltd., are extensively using Lincoln Diesel Welding Units, Improved Fleetweld 5 and Improved Shield Arc 85 electrodes.

The agreement, that from mid-1958 Shell Haven Refinery will be transmitting to Romford 25 million therms of gas per year, largely depends on faultless pipework. The contracts call for the highest standard of welding, and ultrasonic testing is being used in conjunction with radiography by Messrs. Metal and Pipeline Endurance Ltd. in their inspection and double-checking for weld quality.

The combination of Improved Fleetweld 5 and Improved Shield Arc 85 is being extensively used on all pipelines where the 'stove pipe' welding technique, high speeds and high mechanical joint efficiency are required.

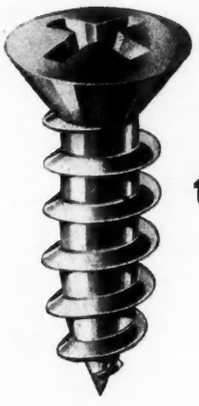
**IMPROVED BRITISH FLEETWELD 5 AND SHIELDARC 85**

Improved Fleetweld 5 conforms to B.S. 639:1952 and is approved by Lloyd's Register of Shipping and the Ministry of Transport and Civil Aviation. It is also being used extensively in the expansion now taking place within the British Petroleum Industry, and the newly developing Petro-Chemical Industries.

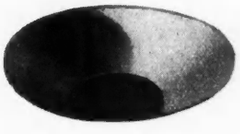
**ENGINEERING MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION at Olympia, 29th August—12th September. See Lincoln Electric on Stand No. 4. Row U, Empire Hall.**

**Largest manufacturers of D.C. Welders in the United Kingdom**

LINCOLN ELECTRIC CO LTD · WELWYN GARDEN CITY · HERTS · WELWYN GARDEN 4581 (5 lines) 920 (5 lines)



**there is**



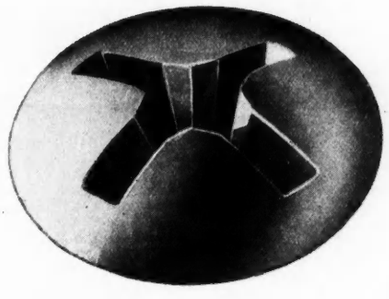
**a plain**

**advantage**

With steadily rising labour costs, every non-essential operation along the production line assumes increasing significance. One of these recurring operations has been the precision thread-cutting of screw holes, which, in assembly, have (equally precisely) to be registered together.

But the tapping, self-locating screw eliminates all this, and permits assembly by less-skilled labour. And the cross-recessed head version is designed for use with power-drivers—without a scratch of damage to worker or job. The tapping screw is demonstrably quicker—cheaper—stronger—safer than the conventional machine screw.

Such plain advantages pay such handsome dividends



**in tapping screws**

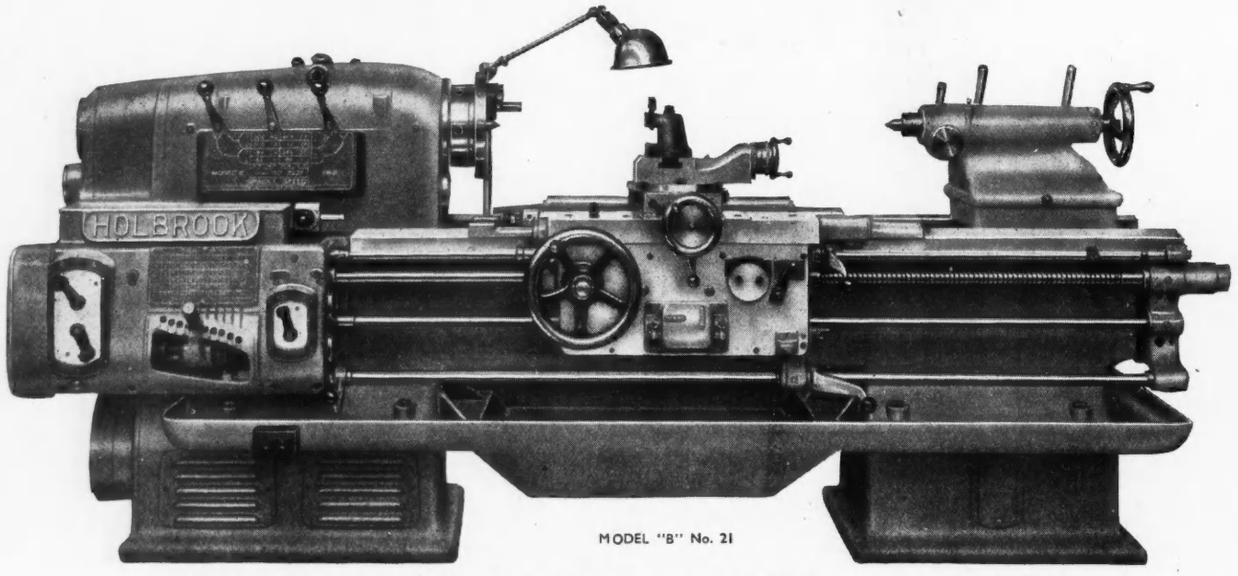
**Linread**

LINREAD LTD · COX ST · BIRMINGHAM 3

SLOTTED AND PHILLIPS RECESSED HEAD MACHINE SCREWS AND TAPPING SCREWS · HIGH TENSILE HEXAGON HEAD BOLTS AND SETSCREWS
AIRCRAFT BOLTS, SCREWS AND RIVETS · SEMS · RIVNUTS · CUSTOM DESIGNED COLD FORGED FASTENERS ALEX SCREWPLUGS.

C

STRATFORD **Holbrook** LONDON




MODEL "B" No. 21

## PRECISION TOOL-ROOM LATHES

**MODEL "B"**

BUILT IN THREE SIZES SWINGING 13-17-21 INCHES OVER BEDWAYS

*The Finest Lathe in its Class*

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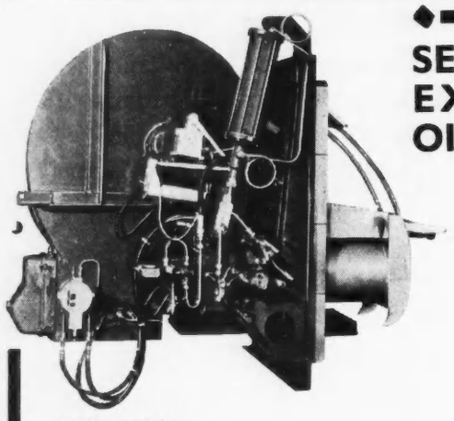
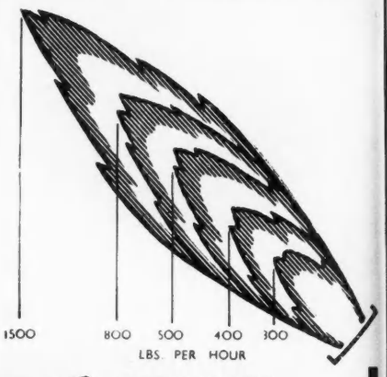


**SEE THESE OUTSTANDING EXAMPLES OF MODERN OIL BURNING TECHNIQUES**

at the
Engineering, Marine, Welding
and
Nuclear Energy Exhibition,
**EMPIRE HALL, OLYMPIA**
August 29 — September 12



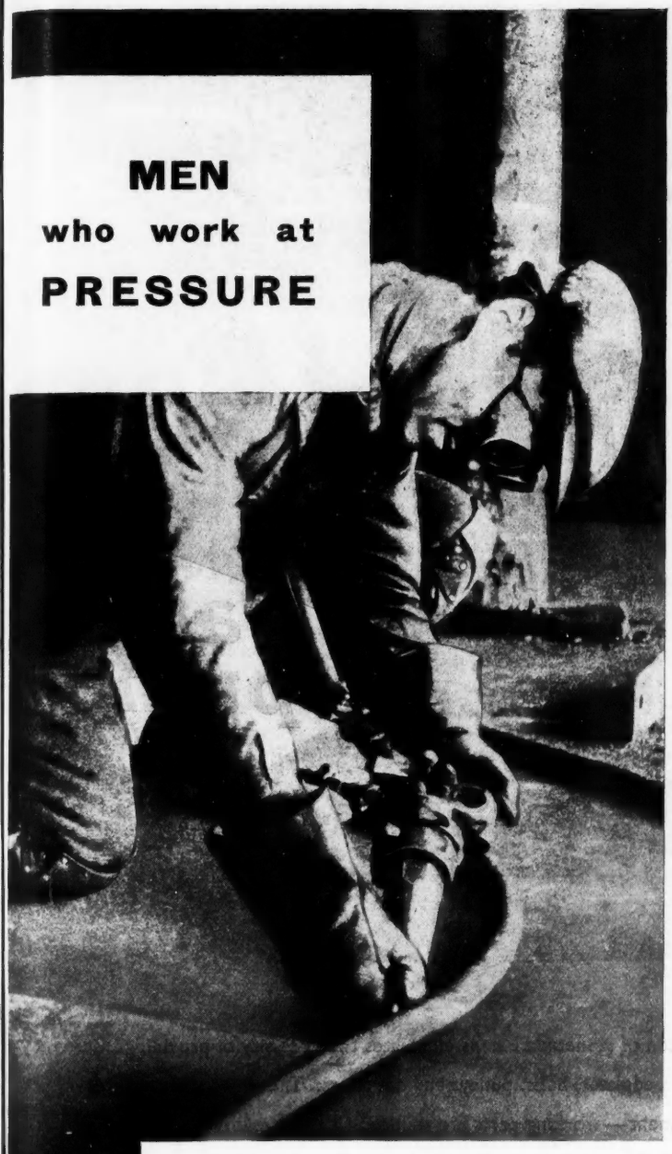

**INITIATOR**
A fully automatic highly efficient remote-operated retractable oil burner.

**MODULATOR**
Oil burner for any duty having constant high efficiency over wide range.

**IGNITOR** A new conception of the ignition of any fluid fuel.

**FUEL FIRING LTD**
**WOODLEY, READING, ENGLAND**
Tel: Sonning 2385/6/7

**STAND 8**
**ROW BB, First Floor**



**MEN**
**who work at**
**PRESSURE**

**. . . know the value of reliable and accurate**

# VALVES

Automatic plate and disc valves are our particular concern. It's astonishing how many different versions of these vital components we have produced in the last seventy years. Our experience is unique —and is at your service.

***Your** valve problems are **our** business*

THE
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COMPANY LIMITED
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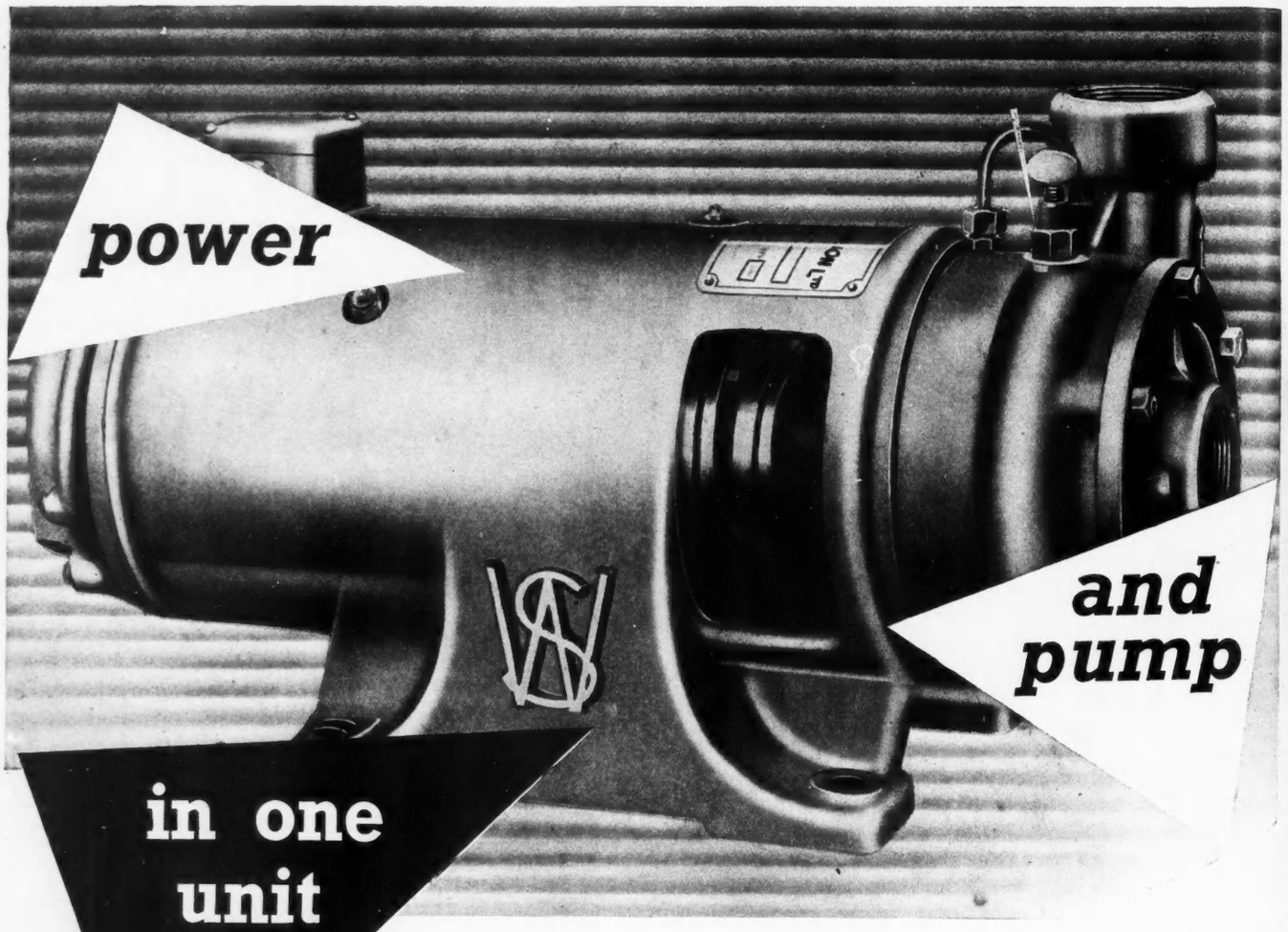
## —of course!

**CHARLES RICHARDS & SONS LTD., DARLASTON, SOUTH STAFFS.**
**Telephone: James Bridge 3188 (8 lines) PBX Wires "Richards Darlaston"**




The unit construction of Monobloc Pumps eliminates the necessity of providing separate driving motors, bedplates, belts, pulleys and couplings. The single shaft ensures perfect and maintained alignment — working parts are reduced to a minimum — space is saved and installation made easy. The pumps will operate in any position, including vertically, providing the pump is below the motor.

# MONOBLOC

## *centrifugal pumps*

**Patent No. 591835**

*RANGE* 3 — 1200 GALS. PER MINUTE HEADS UP TO 375 FT. ½ TO 30 B.H.P. ALL STANDARD VOLTAGES

**For varied purposes including**

AIR CONDITIONING · BRINE CIRCULATION
CIRCULATING SYSTEMS · DRAINING · FILTERING
GENERAL WATER SERVICE · SPRINKLING · SUMP SERVICE
WATER SOFTENING · BOOSTING

# WORTHINGTON - SIMPSON

WORTHINGTON-SIMPSON LTD. NEWARK NOTTS.

# For reliability . . .

**TYPE 81 Ball Joint**

For all general purposes Amal ball joints are the best you can buy. The type 81 (illustrated) has Micrometer adjustment for wear or play; is instantly detachable without tools; Self-locking; Without spring pressure on head making for easy movement without play. Brass body, steel headed pin.

*UNIVERSALLY APPROVED BY LEADING AUTHORITIES ON ENGINEERING*

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AMAL

*Write today for full details of sizes, standard or non-standard.*

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**BALL AND ROLLER JOINTS**

# FORGED BLADES FOR GAS TURBINES

These blades are precision forged in the new forgings shop specially built and specially equipped with the largest capacity in Europe for the production of forgings for the Aircraft Industry.

The materials forged include
STAINLESS STEELS
ALUMINIUM ALLOYS
ALUMINIUM BRONZES
NICKEL ALLOYS AND
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**GARRINGTONS LIMITED, BROMSGROVE, WORCS. and DARLASTON, STAFFS.**

**WELDED STEEL PLATEWORK**

PRESSURE VESSELS
TANKS & CYLINDERS
CHIMNEYS
DRYERS
HOPPERS
CYCLONES
BEDPLATES
ANGLE & FLAT BAR RINGS

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**BRIGHT DRAWN STEEL**
**BRIGHT TURNED BARS**
*(UP TO 12" DIAMETER)*
**BLANKS**

MILD STEEL
FREE CUTTING
CASE HARDENING
HIGH TENSILE—
*to all carbon steel specifications*

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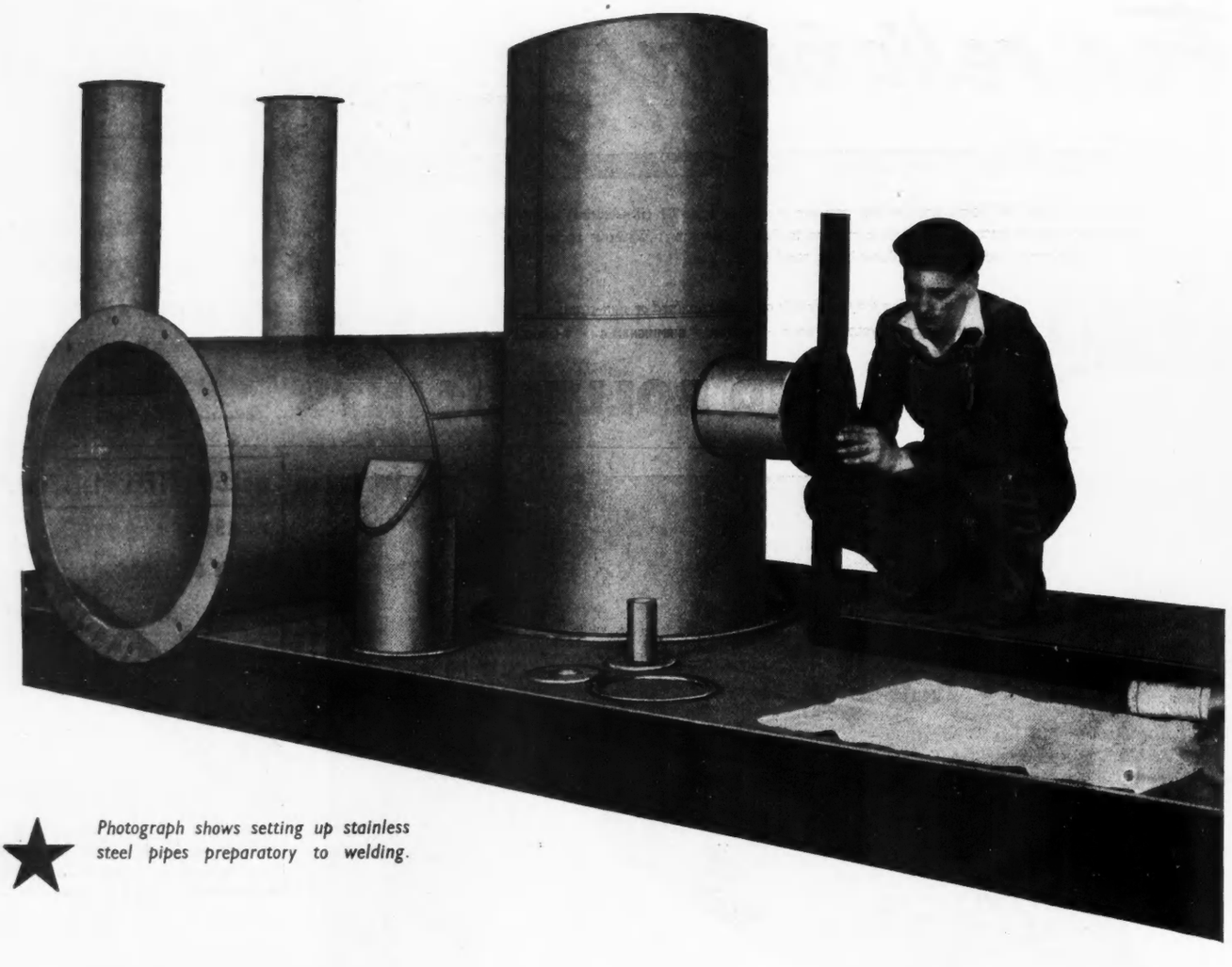
87 HELEN ST GOVAN GLASGOW
*(Prop.: The Steel Company of Scotland)*



*Photograph shows setting up stainless steel pipes preparatory to welding.*

# *Fabrication in* STAINLESS STEEL

Widnes Constructional Department is manned by a staff of highly skilled designers and erectors and is equipped for the production of Tanks for storage or mounting on road vehicles, High and Low Pressure Vessels, Adsorbers, Vertical Air Heater Shells, Crystallizers, Stills, Viscose Kettles etc. in Stainless steel.

## WIDNES FOUNDRY & ENGINEERING Co LTD

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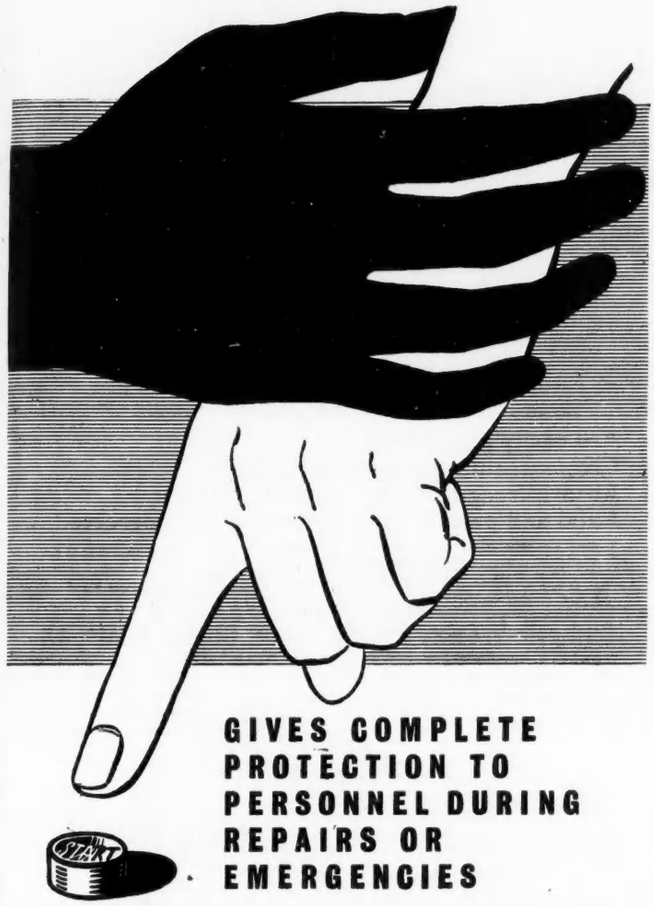
TELEPHONE: WIDNES 2251/4 TELEGRAMS: "FOUNDRY, WIDNES"

ESTABLISHED 1841

W·41.

# SHARP'S

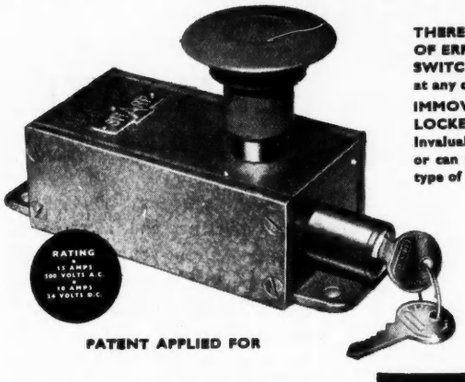
## STOP LOCK SAFETY SWITCH



GIVES COMPLETE PROTECTION TO PERSONNEL DURING REPAIRS OR EMERGENCIES




## ACCIDENTAL RE-START IMPOSSIBLE




PATENT APPLIED FOR

THERE IS NO POSSIBILITY OF ERROR WITH THIS NEW SWITCH. Stopped in an instant at any one of several points.

IMMOVABLE UNTIL UNLOCKED BY MASTER KEY. Invaluable with conveyor plant, or can be fitted to almost any type of machine.

INCORPORATING THE SHARP "SNAP ACTION" CONTACTOR WITH THE 6 TO 1 WIPING FORCE.

**SHARP CONTROL GEAR LIMITED**

LOUNT WORKS, ASHBY de la ZOUCH, LEICESTERSHIRE

A COMPANY OF THE EXPERT TOOL GROUP

TELEPHONE: ASHby 422.
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Sharp Control GEAR LTD

CW.3625

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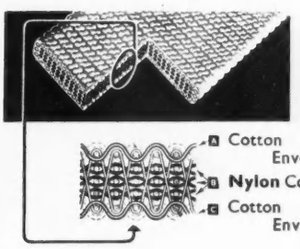
IT'S STRONGER – LASTS LONGER – TRANSMITS MORE POWER – DOES NOT STRETCH

# The latest and greatest of a long and famous line is GRIPOLY Nylon BELTING

THE AMAZING PROPERTIES OF NYLON
ITS HIGH-TENSILE STRENGTH
ITS RESISTANCE TO FATIGUE
ITS ELASTICITY

are incorporated by a special weaving technique which involves pre-stressing the nylon core and locking it by means of a thin cotton envelope of high frictional properties.




*Sole Manufacturers*

**LEWIS & TYLOR LTD,** GRIPOLY MILLS, CARDIFF

Branches in LONDON · MANCHESTER · GLASGOW and Agencies all over the world

**Power Transmission Engineers**

Makers of the world famous Patent GRIPOLY Hair Belting GRIPOLATA Rubber and Canvas Ply Belting GRIPOLASTIC Endless Belts and many other GRIPOLY products.

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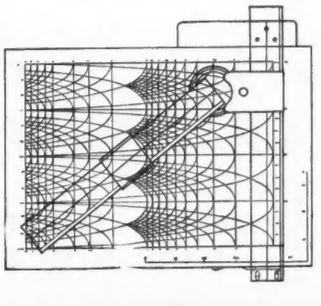
# Better tools for draughtsmen—

***This is the SICI FAN CURVE*** constructed on mathematical principles of which the basic curve is spiral.

This provides for a constant alteration of curvature unobtainable with curves based on the conic section. It is particularly valuable in work connected with flow patterns.



*The SICI Fan curve is only one of a large number of special curves, calculation implements, set squares, tee squares, slide rules, pencils, etc. All Faber-Castell products can be obtained through your usual supplier or in case of difficulty write for literature and name of nearest supplier to sole agents for the U.K*

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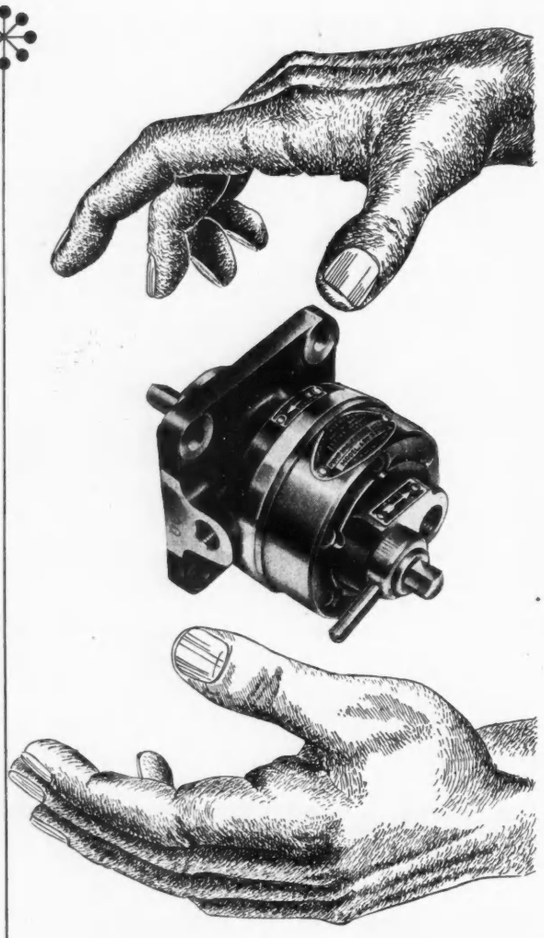

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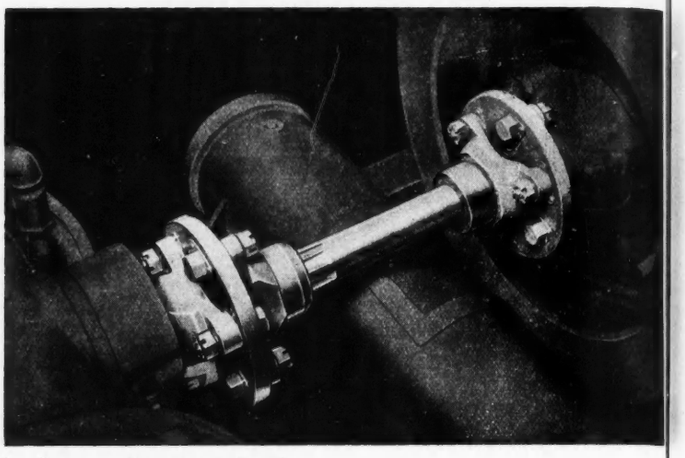

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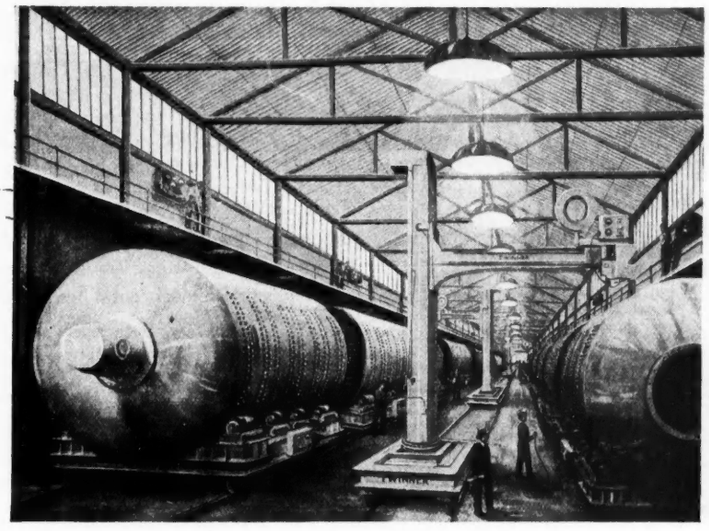

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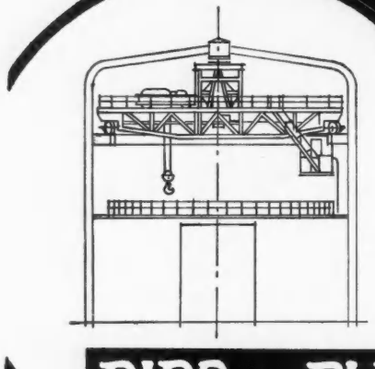

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*Illustration shows ISIS drawing table fitted with ISIS drafting machine.*

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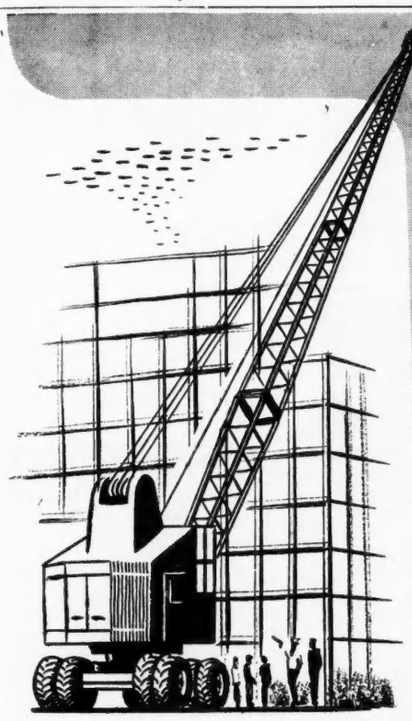

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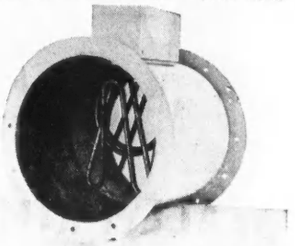

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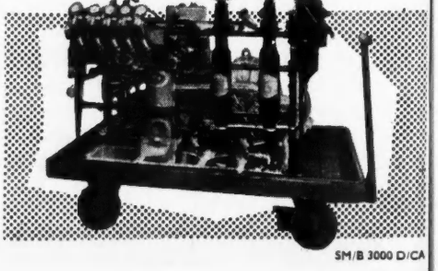

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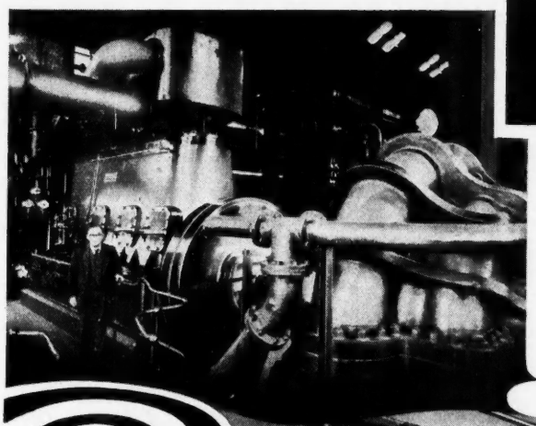

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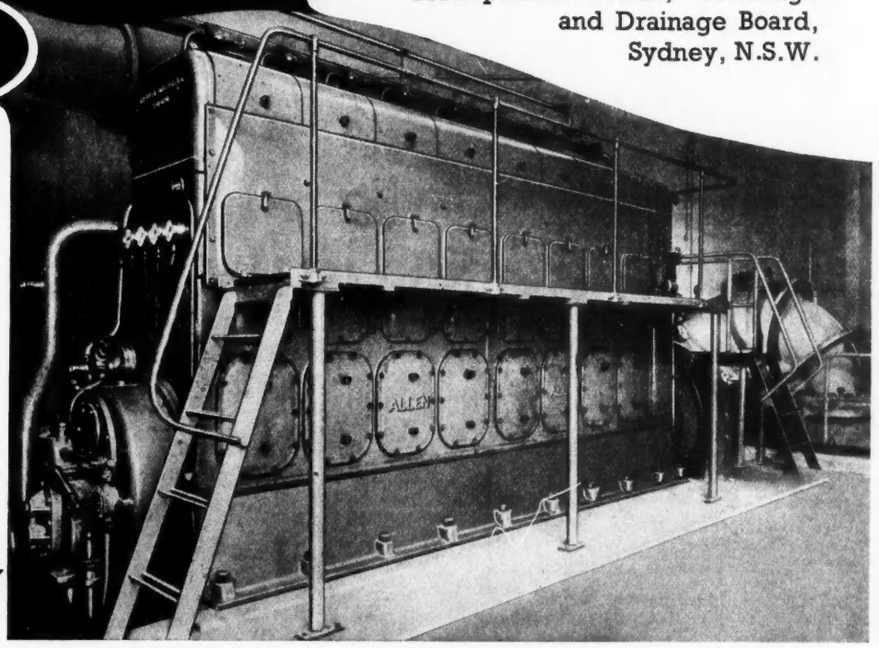

**1904** —— **1956**

Illustrated above is an Allen 1,100-b.h.p. triple expansion steam engine driving a 24-in. pump at 275 r.p.m. in the Potts Hill Pumping Station, Sydney. The engine commenced its working life in 1904, driving a generator in the old Melbourne Tramways Board power station. Since its transfer to Sydney in 1923 for pumping service, the unit has run, non-stop, ten months every year, supplying 620,000 gallons of water per hour at 130 feet head, and is still in regular service.

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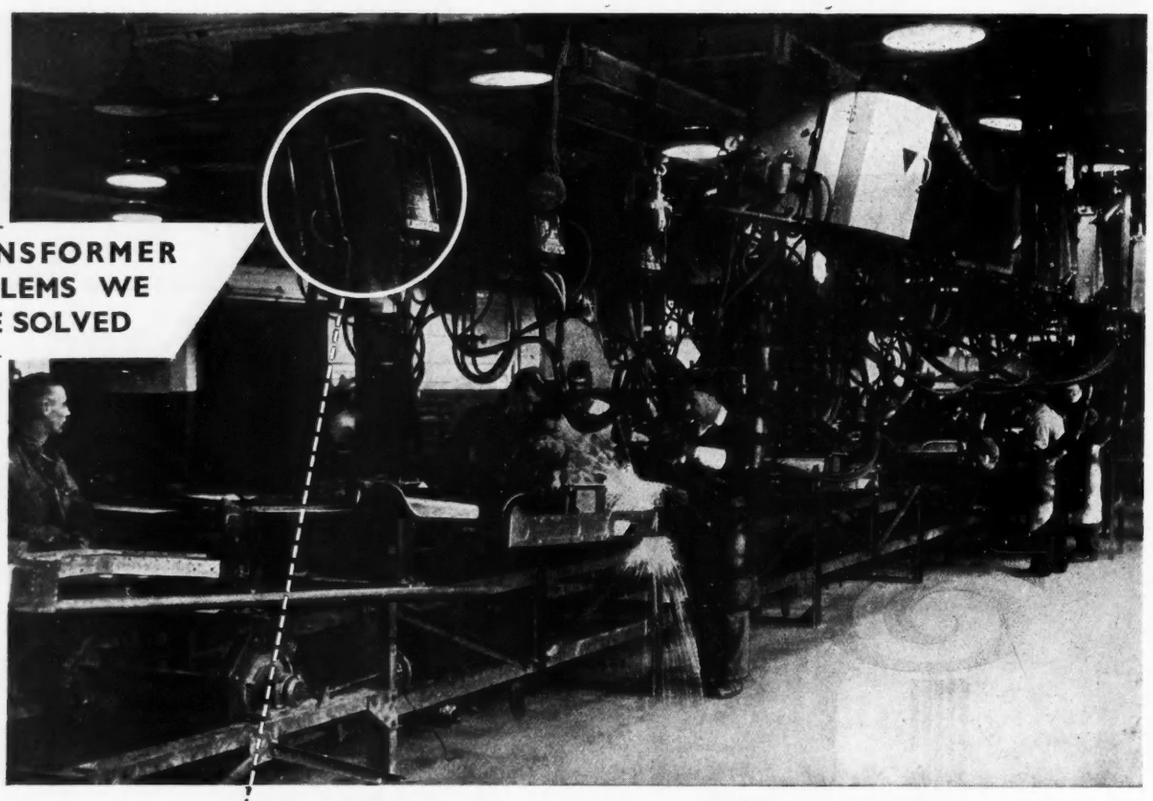

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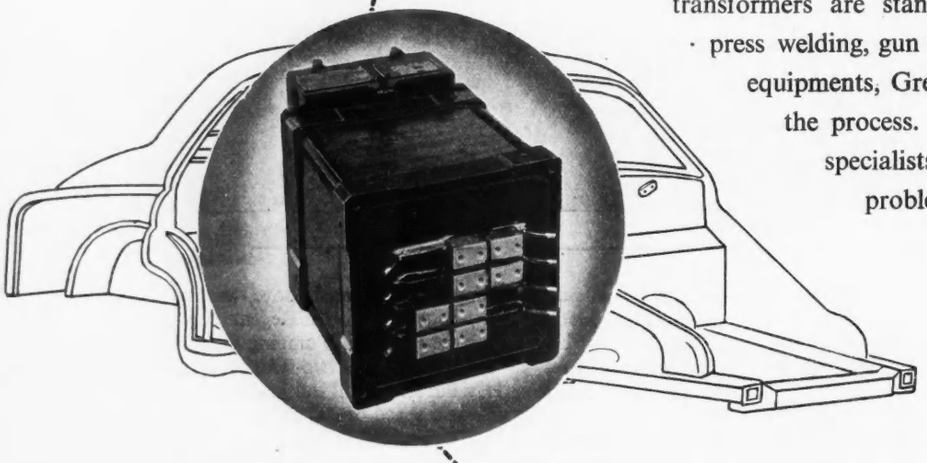

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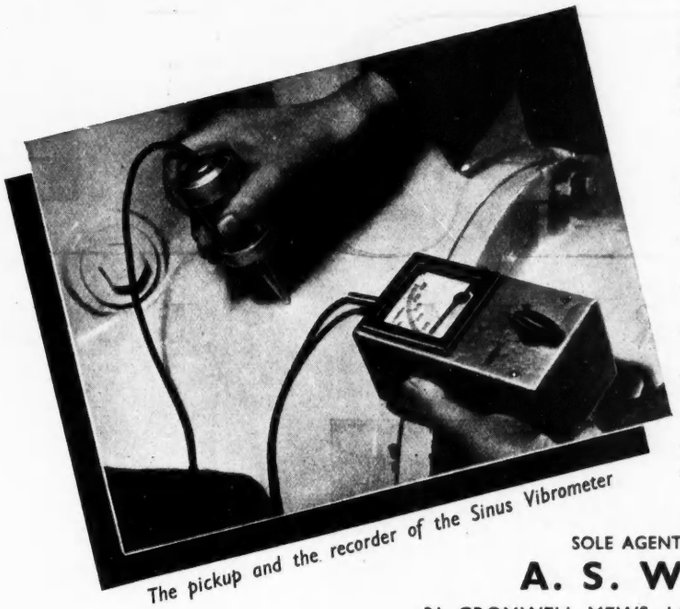

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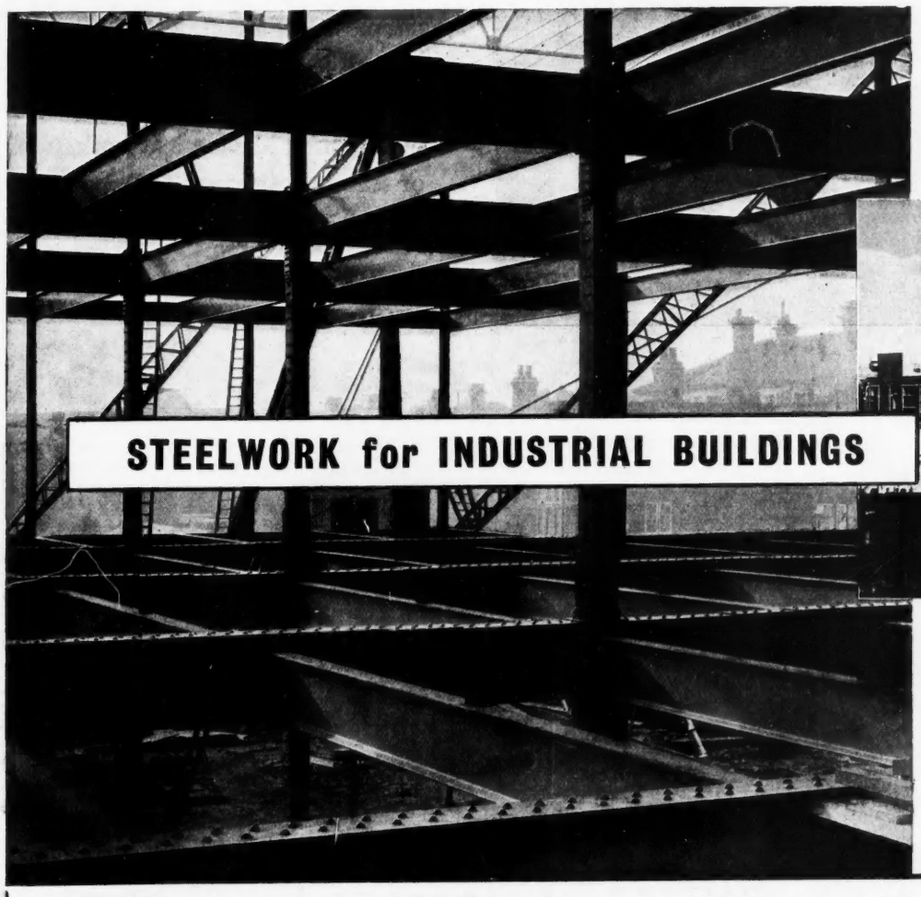

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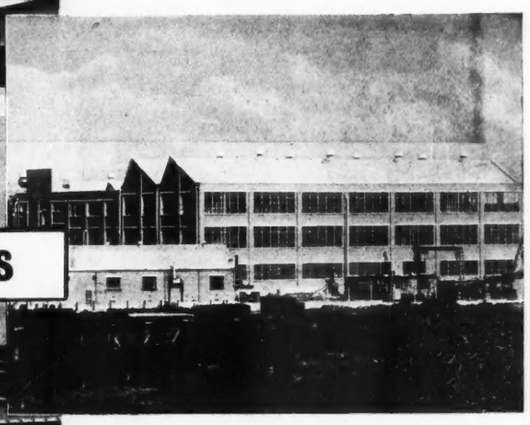

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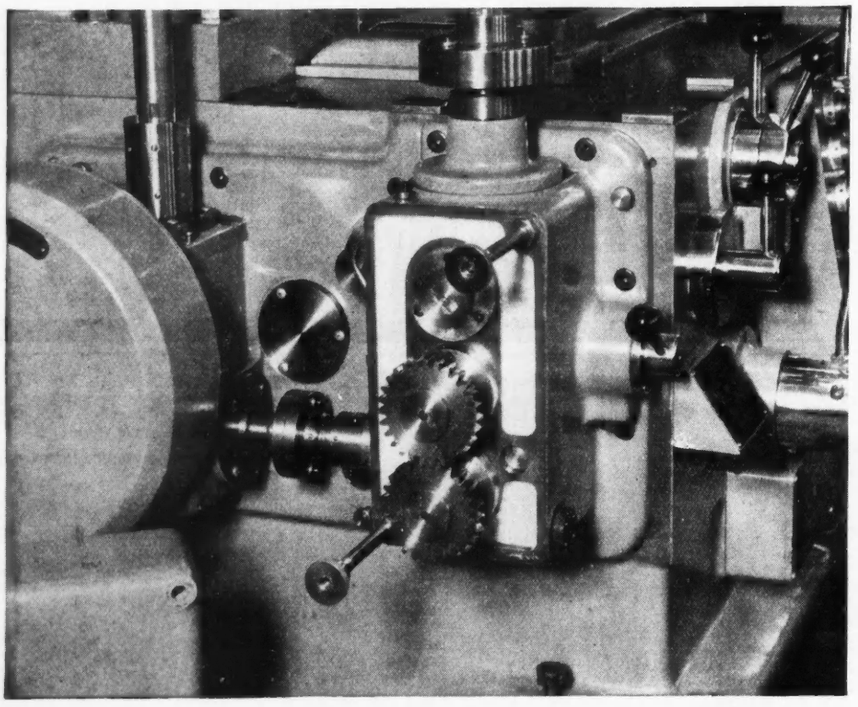
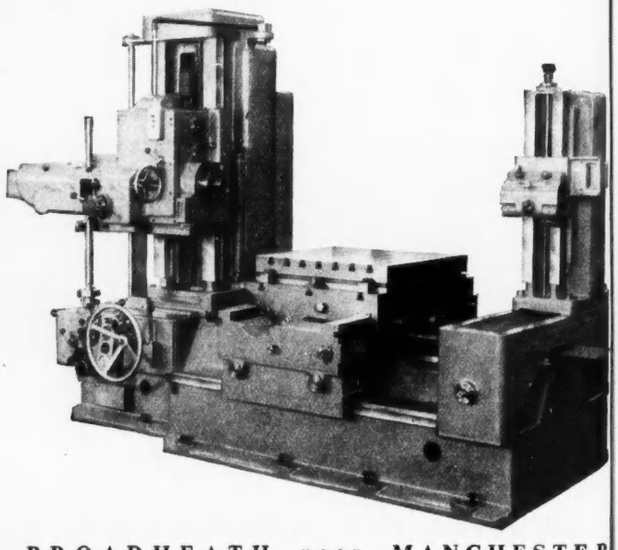


Flexibility of the Kearns No. 0 Horizontal Tool Room Boring Machine is well illustrated in the patented feed system which provides two different feed ranges with six feeds in each. One feed range cuts ·006 - ·062 ins. per rev., and the other 0·5 - 5 ins. per min. Furthermore, either or both feed ranges can be modified. Ask to see one of these Boring Machines at work, or send for catalogue TRB 3



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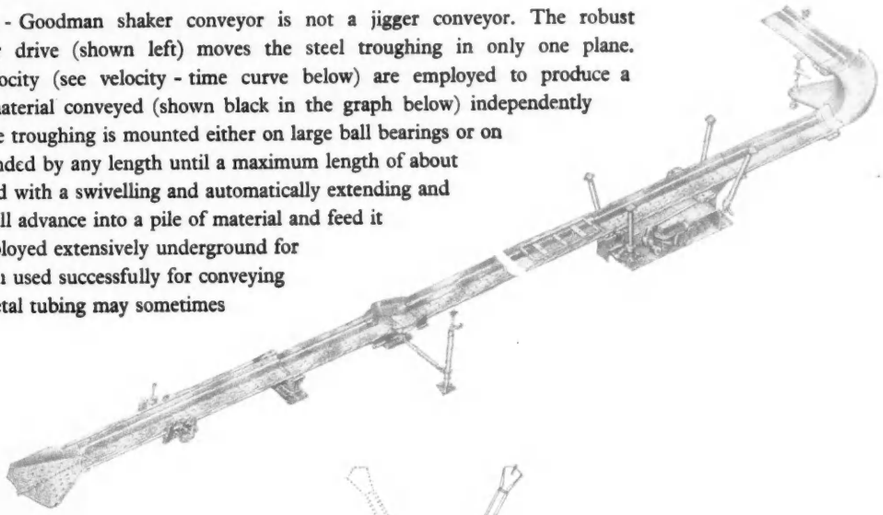
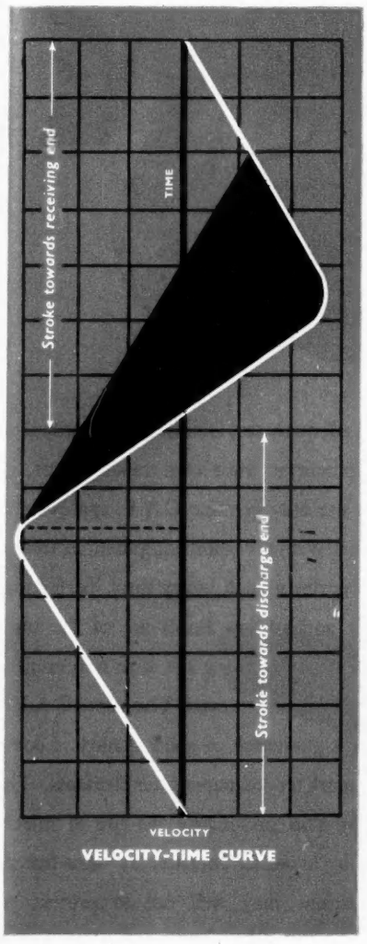
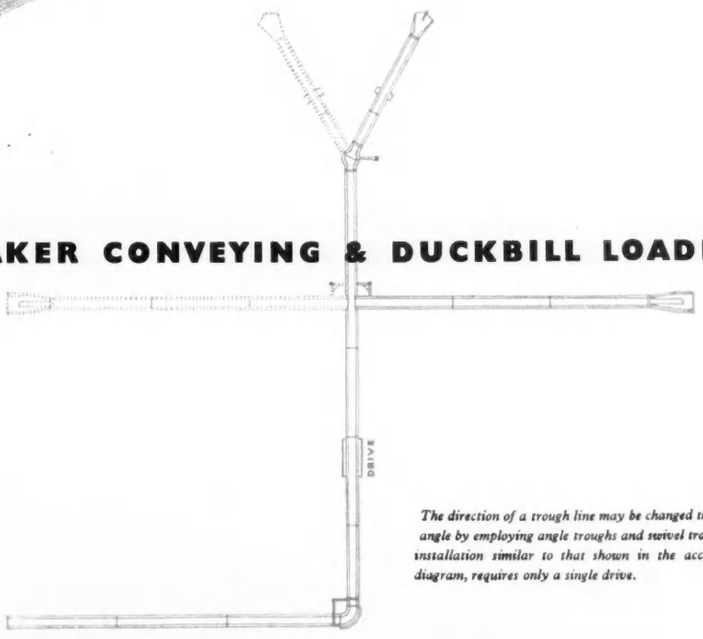
The Distington - Goodman shaker conveyor is not a jigger conveyor. The robust powerful shaker drive (shown left) moves the steel troughing in only one plane. Changes in velocity (see velocity - time curve below) are employed to produce a movement of the material conveyed (shown black in the graph below) independently from the troughing. The troughing is mounted either on large ball bearings or on rollers fitted with ball bearings and is easily extended by any length until a maximum length of about 100 yards is reached. The troughing may be fitted with a swivelling and automatically extending and retracting self-loading "duckbill" head which will advance into a pile of material and feed it onto the conveyor. This machinery has been employed extensively underground for loading and conveying coal and rock and has been used successfully for conveying hot materials in industries other than mining. Metal tubing may sometimes be employed instead of troughing.






VELOCITY-TIME CURVE

## SHAKER CONVEYING & DUCKBILL LOADING

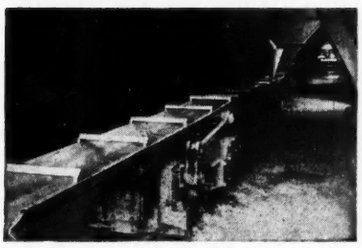



*The direction of a trough line may be changed through any angle by employing angle troughs and swivel troughs. An installation similar to that shown in the accompanying diagram, requires only a single drive.*

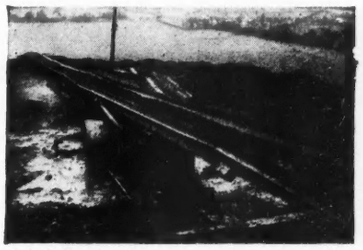
*A single duckbill and shaker conveyor can load material anywhere in this stockyard and convey it to a crushing plant.*

*Shaker conveyor carrying hot sand and small castings in a mechanised foundry.*

DISTINGTON



*Shaker conveyor carrying sinter fines at temperatures sometimes reaching 300°C.*



*A duckbill and shaker conveyor load and convey colliery waste at the rate of 7,250 tons per week over a long period.*

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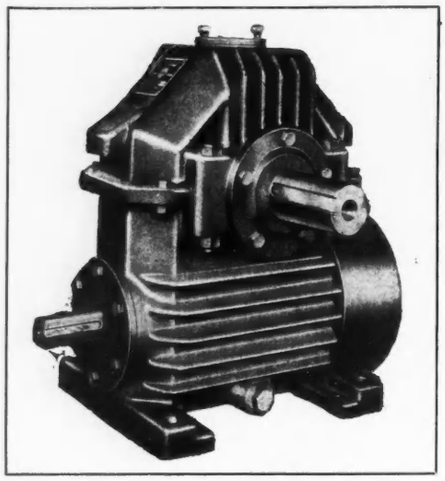

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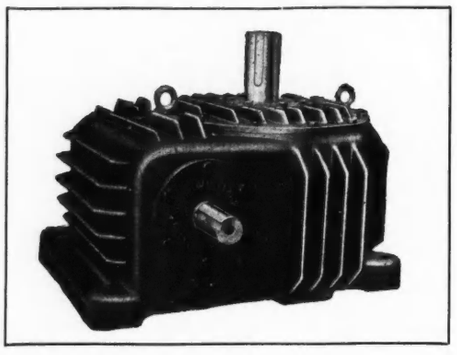

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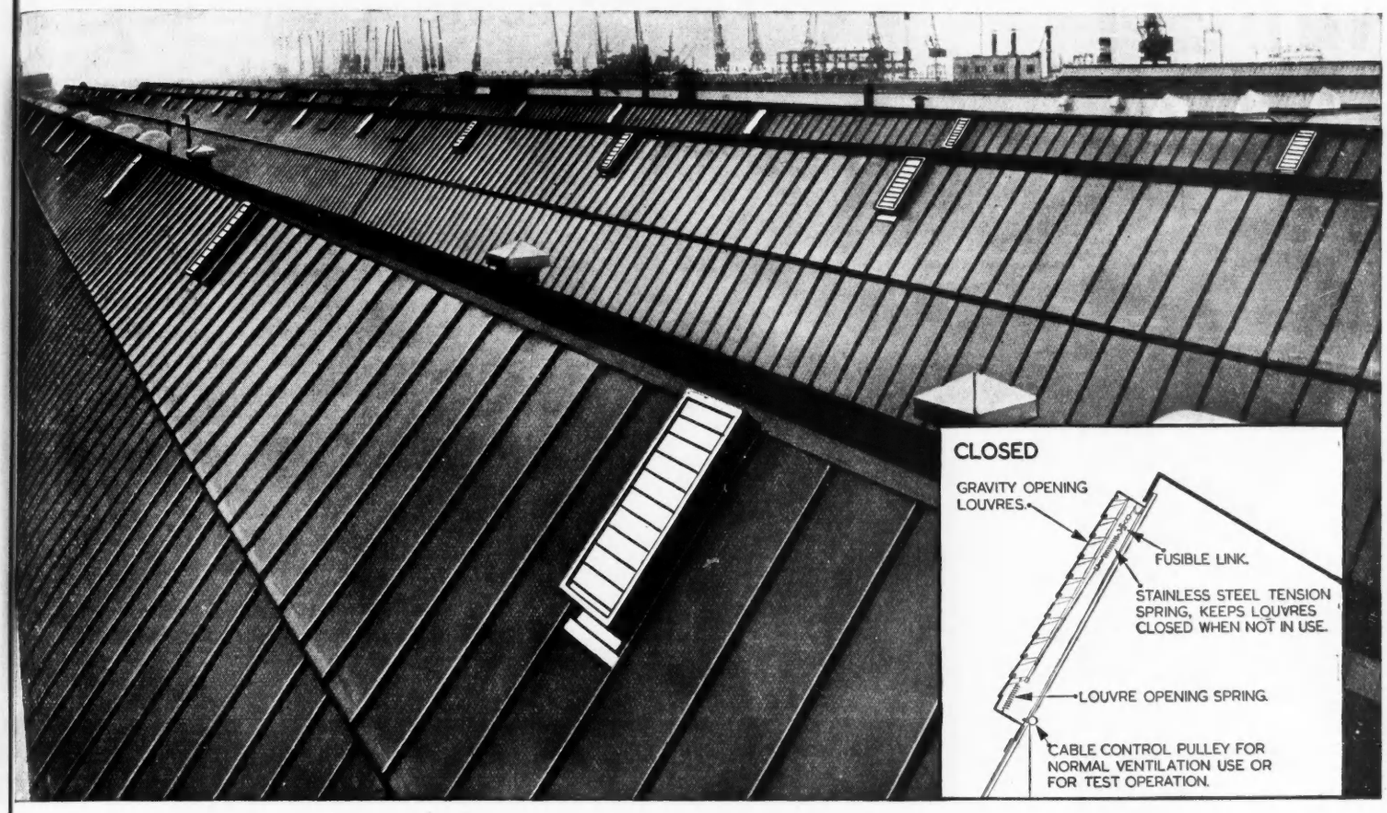

CLOSED
GRAVITY OPENING LOUVRES.
FUSIBLE LINK.
STAINLESS STEEL TENSION SPRING, KEEPS LOUVRES CLOSED WHEN NOT IN USE.
LOUVRE OPENING SPRING.
CABLE CONTROL PULLEY FOR NORMAL VENTILATION USE OR FOR TEST OPERATION.

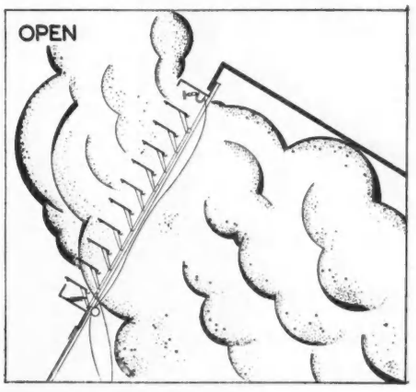
## with the COLT DUAL PURPOSE FIRE VENTILATOR

### at AC-Delco, Division of GENERAL MOTORS LTD., SOUTHAMPTON.

A study of industrial fires in Great Britain and in America has shown that the primary cause for the spread of fire is the super-heated air, smoke and explosive gases trapped under the roof. They build up in heat and intensity from the fire below and cause flash fires. Furthermore, the smoke rapidly extends downwards, entirely filling the premises and preventing the work of the fire fighters.

Colt have successfully solved this problem with the design of the Dual Purpose Fire Ventilator which **provides ventilation during normal conditions and—in the event of fire—functions as a heat and smoke exhaust.**

The installation of heat and smoke exhausts is standard practice in America and is rapidly being adopted by leading industrialists in the United Kingdom. Already, 1,290 Colt Dual Purpose Fire Ventilators have been installed in General Motors buildings in this country.




*The insets illustrate the action of the ventilator as a Heat and Smoke Exhaust. In the event of fire, the fusible link fuses, providing Automatic Escape for Super-Heated Air and Smoke.*

*Write to Dept. S9/8C, for paper "Some Aspects of Fire Protection in Industrial Buildings" by M. J. Reaney, which deals fully with this matter.*

**COLT**

**VENTILATION**

COLT VENTILATION LTD · SURBITON · SURREY

*TELEPHONE: ELMBRIDGE 6511 (10 lines)*

*U.S.A. Subsidiary: Colt Ventilation of America Inc., Los Angeles.*

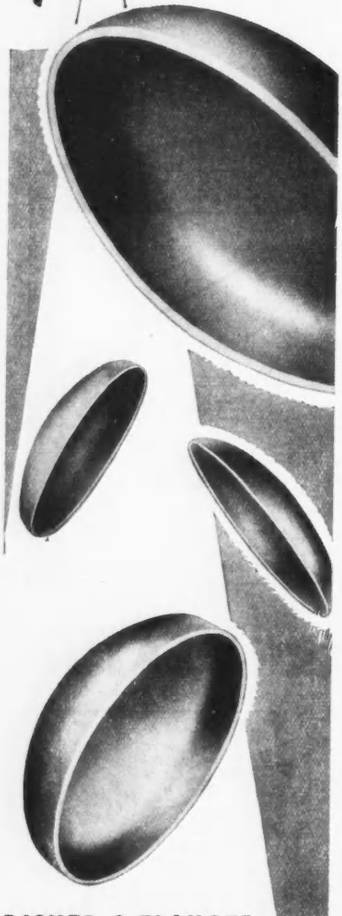
*Branches at: Birmingham, Bradford, Bridgend (Glam.), Bristol, Coventry, Dublin, Edinburgh, Glasgow, Liverpool, London, Manchester, Newcastle-upon-Tyne, Sheffield, and Warwick.*

*Agents in: Australia, Belgian Congo, Canada, Cyprus, India, Indonesia, Madagascar, Malaya, Mauritius, New Zealand, Pakistan, Portugal, North and South Rhodesia, and South Africa.*

C 579A

D

# ABBOTT of NEWARK



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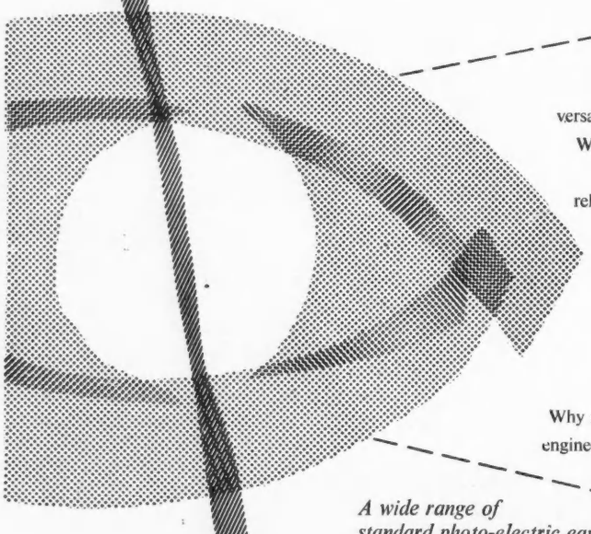
**G.E.C. PHOTO-ELECTRONIC EQUIPMENT AIDS FOR INDUSTRY**



The photocell is probably one of the most versatile electronic devices available to industry. When used in conjunction with a light source and a simple valve amplifier it provides a reliable and economical switch, which has the great advantage of not requiring physical contact for operation.

The applications are unlimited—if you have a photo-electronic mechanisation problem of any kind G.E.C. photocell switches can provide the answer.

Why not consult the G.E.C.? A staff of specialist engineers is at your service . . . ready to advise you.

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*Write for literature on G.E.C. photo-electric equipment to Valve and Electronics Department,*
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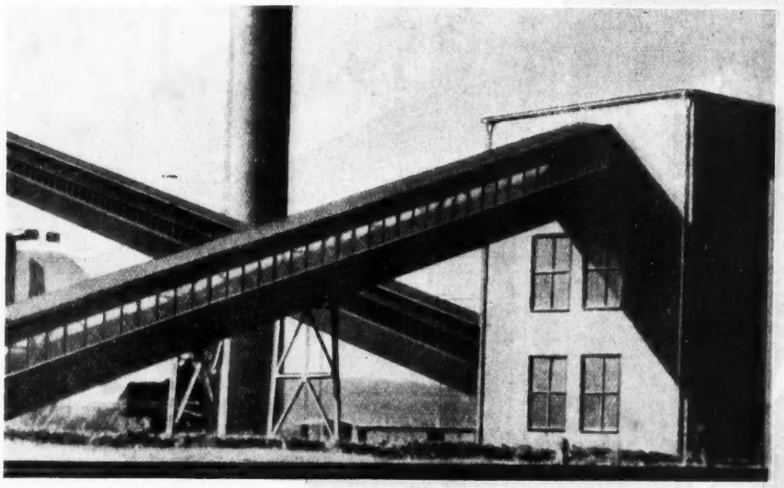

B W

**MASCHINENFABRIK BUCKAU R. WOLF**
**AKTIENGESELLSCHAFT • GREVENBROICH-NEUSS**
WESTERN GERMANY

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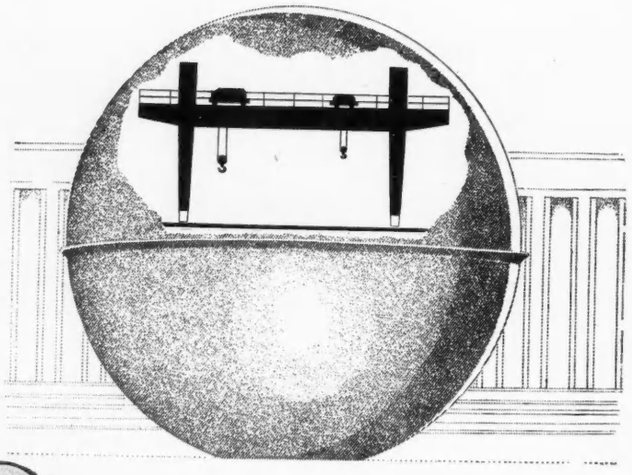
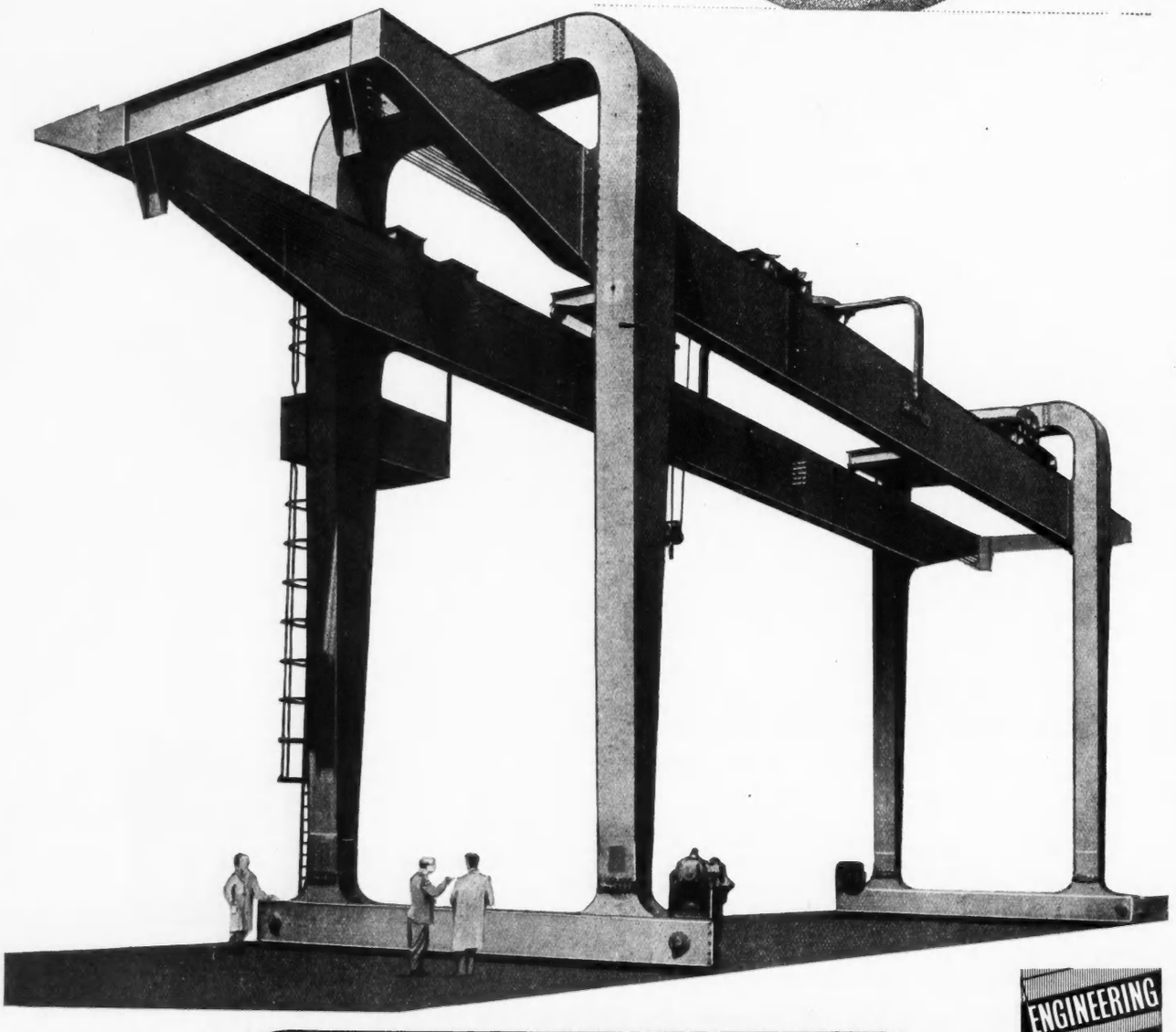
# for DOUNREAY

This
**33 TONS ROTATING GANTRY CRANE**
is now installed at the Charge Face in the Reactor Sphere.
It is 115 feet long and 50 feet high. It was delivered precisely on time.





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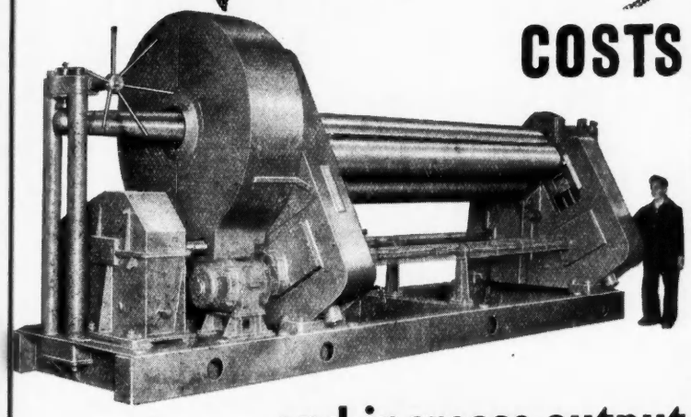

## and increase output

Engineering, Marine, Welding, & Nuclear Energy Exhibition
Stand 6A
GRAND HALL, OLYMPIA
Aug. 29-Sept. 12

The illustration shows 3-roll machine — capacity 12'0" × 1" MILD STEEL PLATE. There are also BRONX Press Brakes, Guillotines, etc.

● For most types of Cylinder or Shells using this machine, preliminary pre-bending by means of a separate Press is completely unnecessary.
Great care and attention has been paid to provide the easiest system of control for the operation. In addition to circling, these machines are also suitable for all types of conical work.
There is a wide range of massively built Bronx Plate Bending Rolls to give consistent accuracy with thinnest to thickest steel plates up to 25ft. wide.
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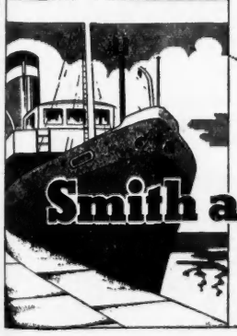
Metals deposited include: Zinc, Tin, Aluminium, Copper and all its alloys, Cadmium, Monel Metal, etc.



**Smith and McLean Ltd.**
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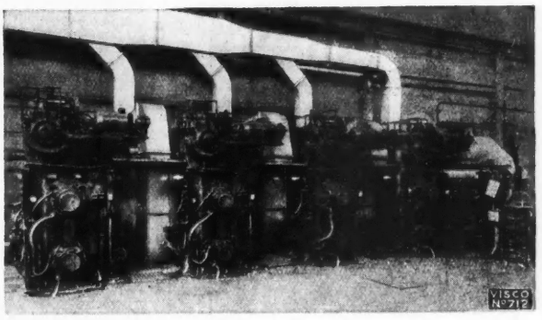
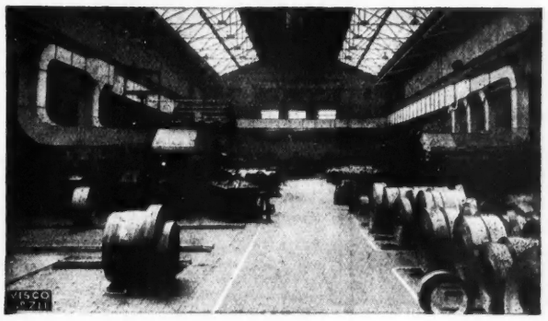
*Photos by courtesy of Messrs. Guest, Keen & Nettlefolds Ltd.*




# VISCO

## FUME REMOVAL PLANT at a CARDIFF STEELWORKS

The accompanying photographs show a combined Fume Removal plant for a 4-Stand Tandem Mill and Reversing Mill installed by The Visco Engineering Co. Ltd., at the Castle Works of Messrs. Guest, Keen & Nettlefolds Ltd.

The fumes are drawn off through hoods above the reels and pass through ducting to an oil eliminator. The precipitated oil is collected in a tank under the eliminator and the cleaned air discharged to atmosphere.

Similar "Visco" Fume Removal Plants are in operation at a number of other Steelworks in South Wales, including:—

The Ebbw Vale Works of Messrs. Richard Thomas & Baldwins Ltd.—Newport Works of The Whitehead Iron & Steel Co. Ltd.—Orb Works of The Steel Company of Wales Ltd. (Lysaght Division)—Velindre Works of The Steel Company of Wales Ltd.

Consult us on all Fume Removal problems. Write for "Modern Dust Collection and Fume Removal" List No. 532.]

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Perfect pressure
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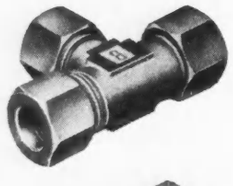

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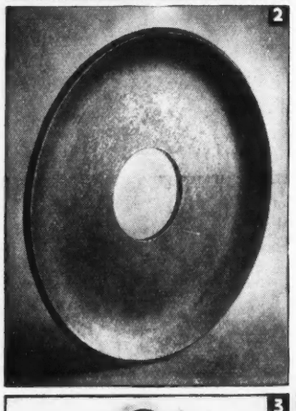
1


2

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2 Produced from 15/32" Mild Steel. Pressed cold in tools fitted with Harper Meehanite Inserts. 28,000 pressings have been produced without any tool reconditioning.

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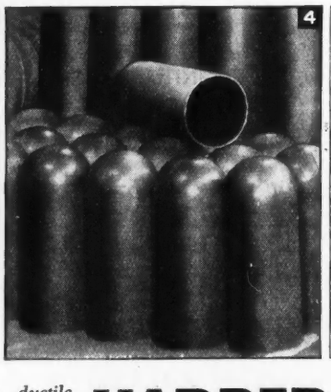
4 Produced from 14 S.W.G. Mild Steel. 10,700 pressings produced; tools only reconditioned once.

5 Produced from 10 S.W.G. Mild Steel. 2,350 pressings produced without any tool reconditioning.

3


4

5

*Harper quality covers grey iron, ductile iron and Meehanite castings, also metal pressings and other finishes and sub-assembly work.*

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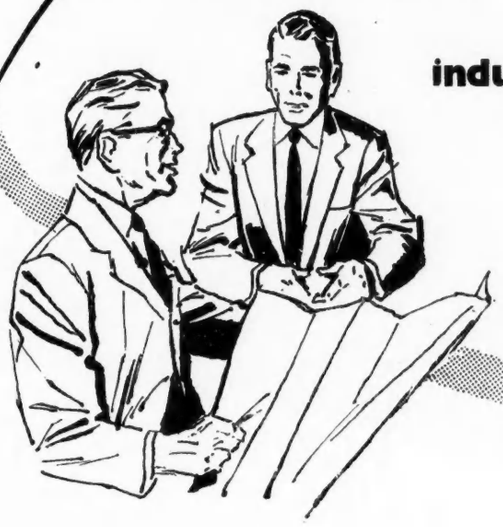
# "What do Sperry know about industrial control systems?"

*asked the Design Engineer*



"Seriously — Sperry are specialists in the aircraft and marine fields," said the Design Engineer. "What would they know about *industrial* control systems?"

"Sperry are specialists in *remote control servo systems*," said the Chief Engineer. "They are specialists in the aircraft and marine fields because they have successfully applied their systems to aircraft and ships for over 40 years. Sperry don't *build* aircraft and ships — they do the servo work — and it's a control system we're after; *one we can depend on*. That's why I'm calling in Sperry."

"But we may not need a *complete* system here," said the D.E.

"Complete system — or components — I still say call in Sperry. They wrote us about it only the other week.

"Here's their letter — third para., quote:

*Our general outlook for such collaboration is a very flexible one. If desirable we could undertake the engineering and supply of complete systems to your specified requirements — or alternatively, could supply all or any of the basic component items involved, such as transducer-operated hydraulic valves, actuators, synchros, tachometers, amplifiers . . .*"

"They seem to have it pretty well buttoned up," admitted the D.E.

"Well, get them on the 'phone. We can go down to Brentford — or better still ask them to come up here."

"The sooner the better."

"EALing 6771."

**SPERRY**

**SERVO CONTROL SYSTEMS**

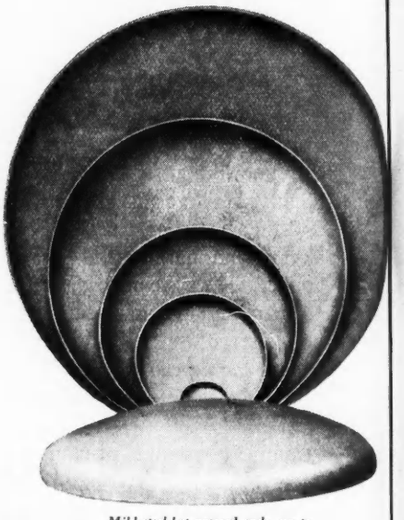
**FOR INDUSTRY**

*SPERRY GYROSCOPE COMPANY LIMITED . GREAT WEST ROAD . BRENTFORD . MIDDLESEX . Telephone: EALing 6771*

*Lower sections of storage hoppers in $\frac{1}{4}$" thick aluminium alloy plate, welded by the Argon-Arc process.*

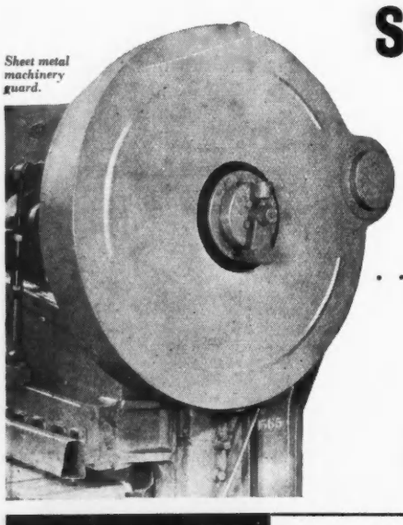
# BRABY

## Fabricated Metal Plate and Sheet Metal Work



*Mild steel hot pressed ends, up to 6' 0" diameter, for pressure vessels.*

*Sheet metal machinery guard.*



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OTHER OFFICES: 110 Cannon Street, **London**, E.C.4 (Export). TELEPHONE: MANsion House 6034
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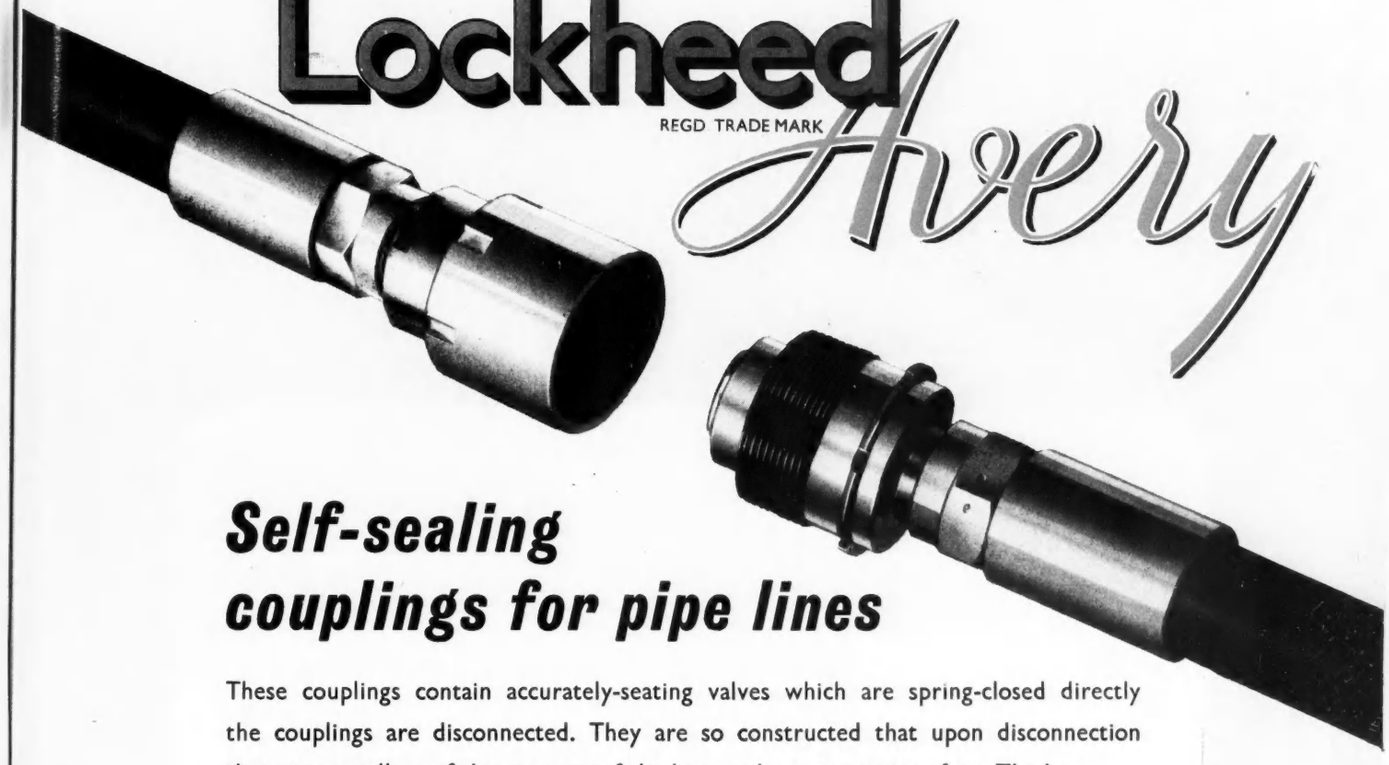
Palace Street, **Plymouth**. TELEPHONE: 62261

Lockheed
REGD TRADE MARK
Avery

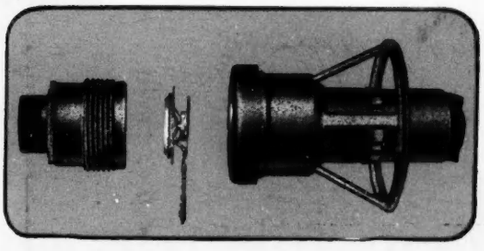


## Self-sealing couplings for pipe lines

These couplings contain accurately-seating valves which are spring-closed directly the couplings are disconnected. They are so constructed that upon disconnection there is no spillage of the contents of the hose and no entrapping of air. The hoses are made in various qualities and sizes, some are available for very high pressure, fire-proof when required, and they lend themselves to a great many applications for air and gases under pressure, for oil, fuel and hydraulic fluid.

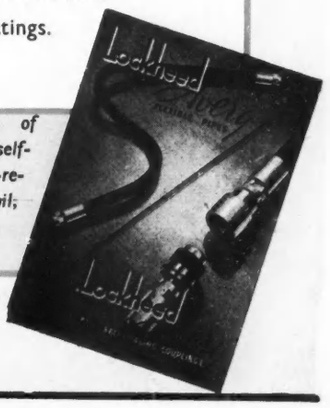
More than a million of these fittings have been supplied, and they have been standardized on all British aircraft and for British Railways for the refuelling equipment on diesel locomotives. Used in this way, the couplings give the most efficient form of refuelling, being connected and disconnected in a fraction of a minute; there is no need to up-end the hose and there is no loss of fuel. The self-sealing couplings screw on to standard pipe end-fittings.

**Lockheed-Avery**
**FLEXIBLE PIPES**
are made in a wide range of sizes and types. They are of high quality, ranging up to the special types used upon aircraft; they have easily detachable and re-usable end fittings.



*Typical Lockheed-Avery refuelling connections, shown disconnected.*

*The comprehensive catalogue of Lockheed-Avery flexible hoses, self-sealing couplings and pressure-replenishing connections for fuel, oil, etc., will be sent on application.*

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OIL REFINERY
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ENGINEERS

THE
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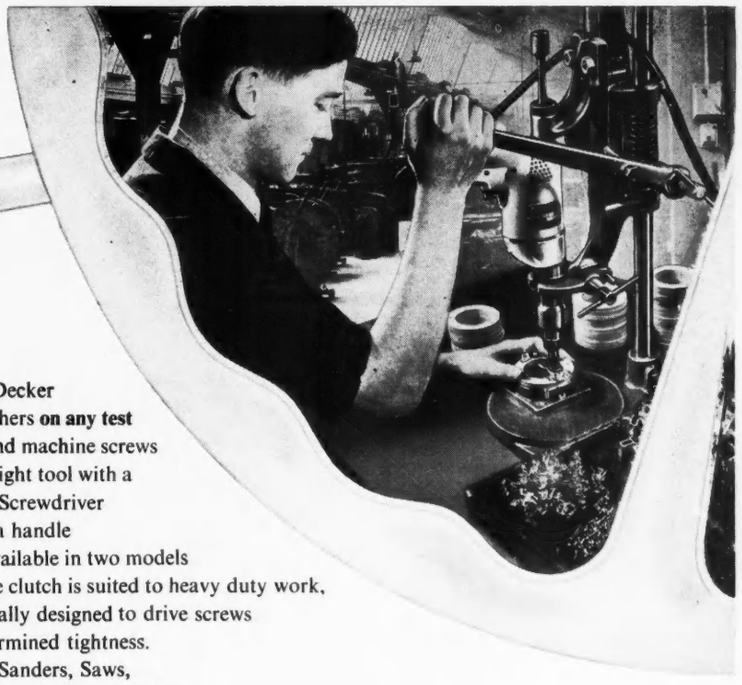
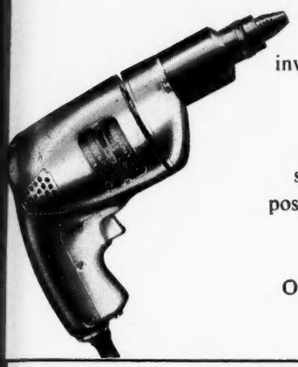
# He's passed his driving test





He knows that with a Black & Decker Screwdriver he can outdrive all others **on any test** involving driving wood, self-tapping and machine screws and light nut-running. A lightweight tool with a really big capacity, the No. 12 Screwdriver has increased motor power and a handle shaped to give more finger room. Available in two models positive or double clutch — the positive clutch is suited to heavy duty work, while the double model is specially designed to drive screws automatically to a predetermined tightness.
Other Black & Decker tools include Sanders, Saws, Drills, Hammers, Bench and Portable Grinders.

**No. 12 (Positive Clutch) SCREWDRIVER**

Has a capacity on Wood Screws up to No. 12 × 2″; on Self-tapping Screws up to ¼″, and Machine Screws and Nuts up to ¼″ diam. This model, although weighing only 3¾lbs., is ideal for heavy duty work.

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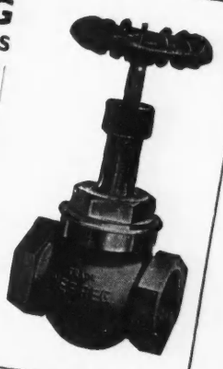

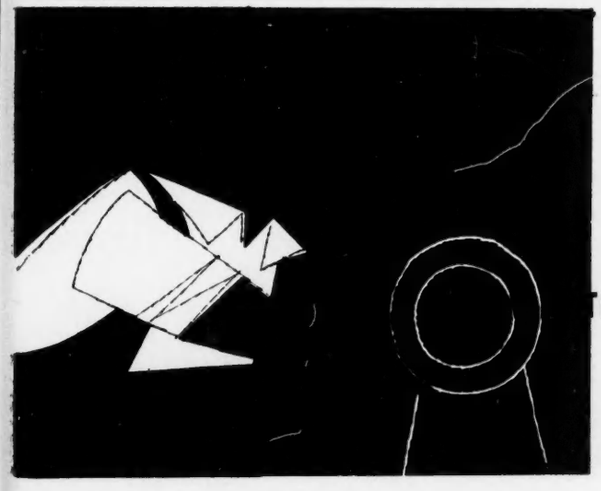

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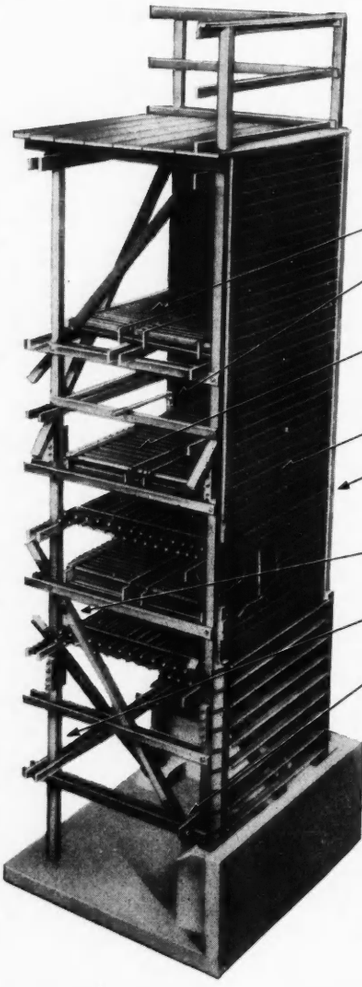

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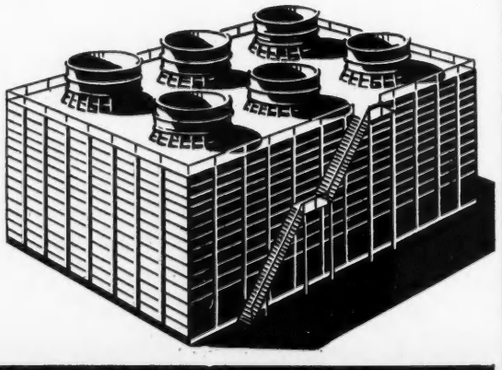

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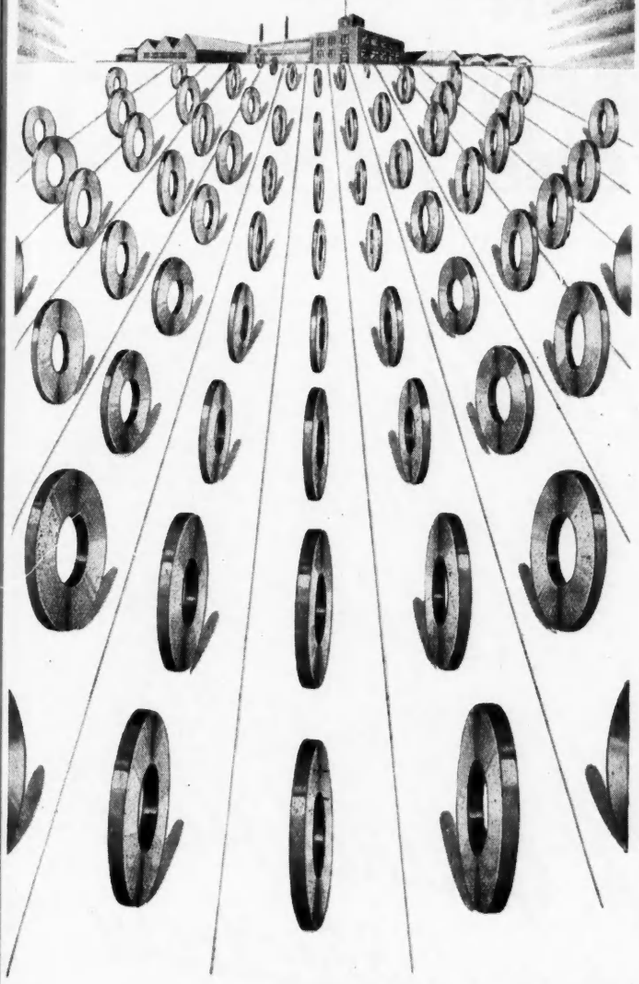

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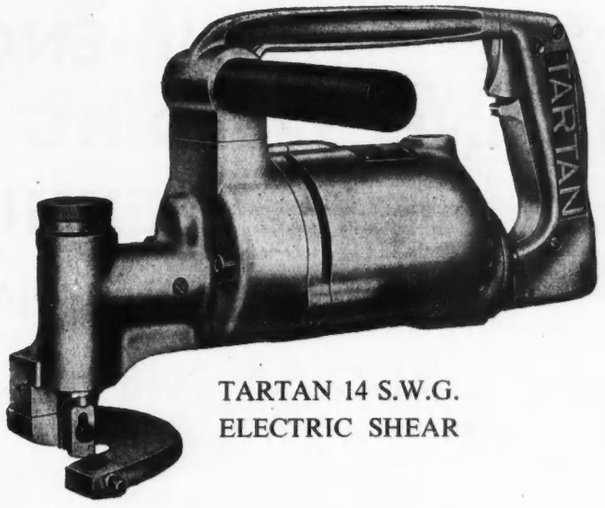


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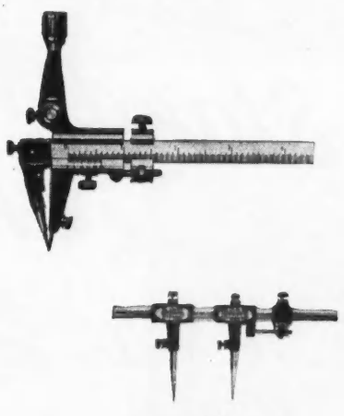

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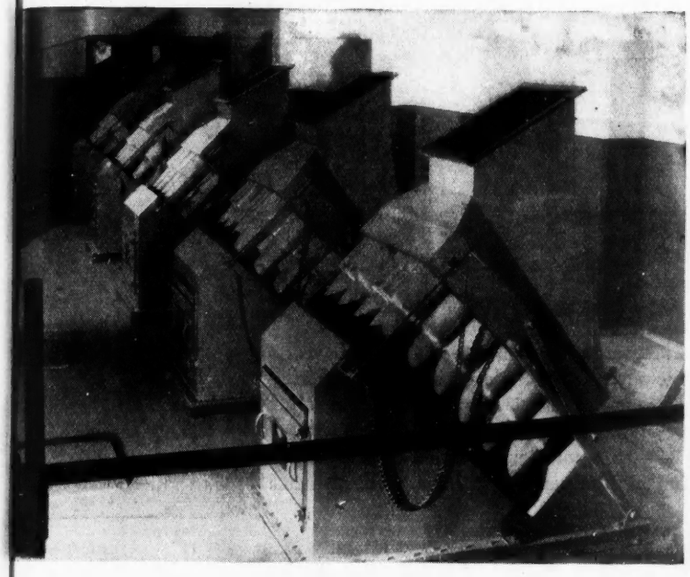

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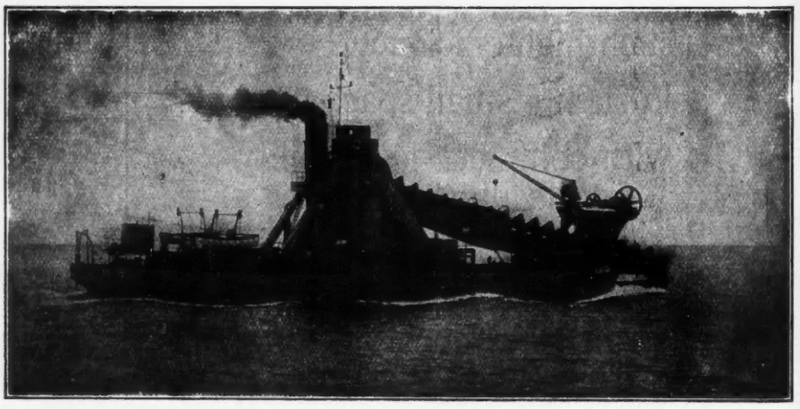

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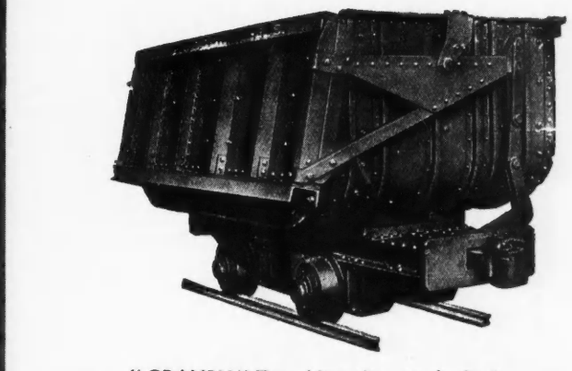

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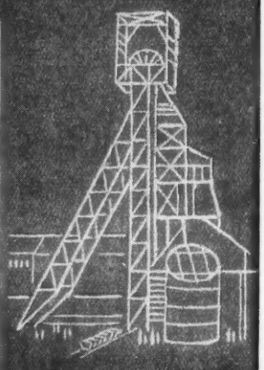

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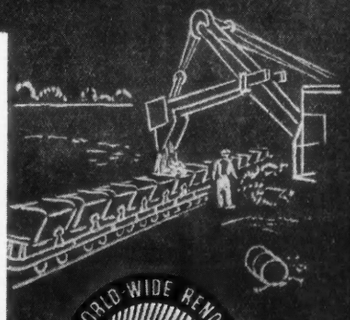

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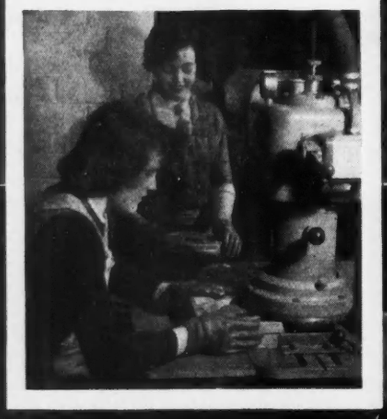

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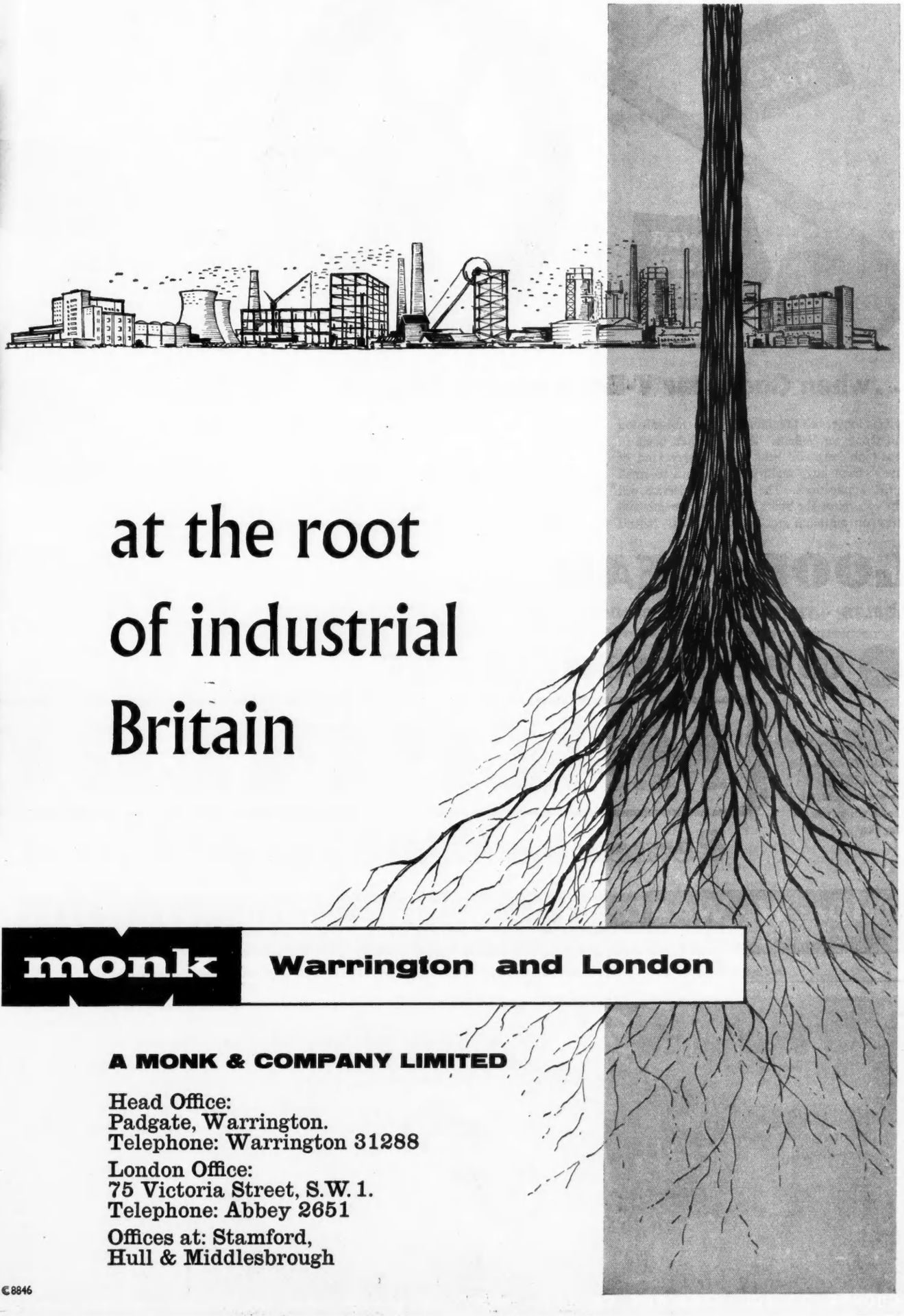

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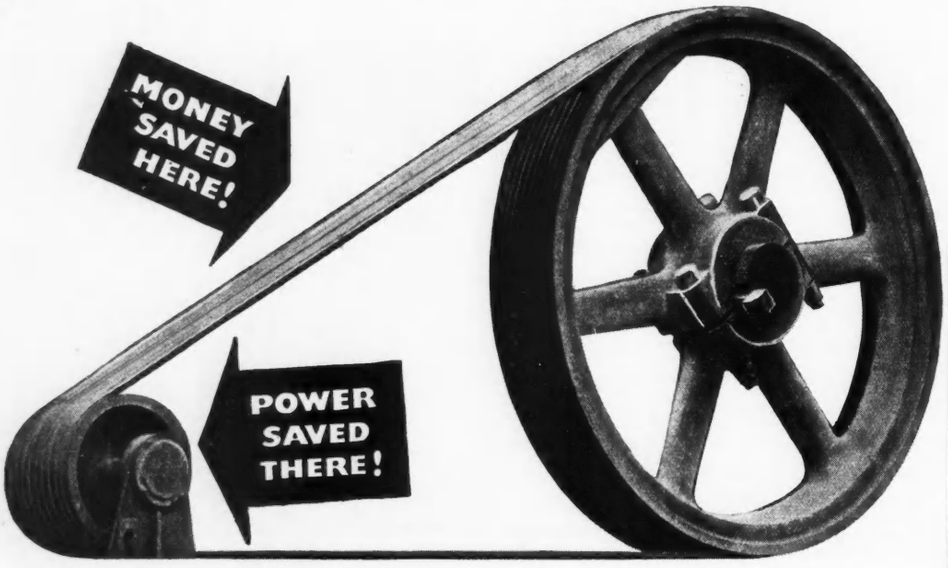


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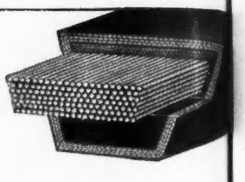

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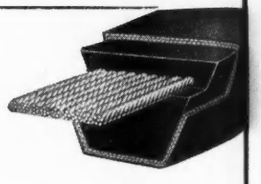

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# THE ENGINEER

VOL. 204 No. 5301 AUGUST 30, 1957

CONTENTS

LEADING ARTICLES—
Low's Carthorse Speaks ... ... ... 289
Technology and Wisdom ... ... ... 290
L.C.C.'s New Town ... ... ... ... 291

ARTICLES—
Aircraft Problems ... ... ... ... ... 291
Defensive Homing Missile. (Illus.) ... 295
Design of the Foundations of the Shell Building, London. (Illus.) ... ... 298
Engineering and Marine Exhibition. (Illus.) ... ... ... ... ... ... 305
International Commission on Irrigation and Drainage ... ... ... ... ... 291
Model Engineer Exhibition ... ... ... 292
Nitrogen Atmosphere Generator ... ... 304
Oil Hydraulic Circuitry... ... ... ... 292
Performance and Efficiency Tests on B.R. Class " 8 " Locomotive. No. II. (Illus.) ... ... ... ... ... 292
Radial Flow Machinery. (Illus.)... ... 296
Radio Show ... ... ... ... ... ... 291
Supersonic Turbo-Jet " Iroquois." (Illus.) ... ... ... ... ... ... 304
Thorium Zero-Energy Reactor ... ... 291
100 Years Ago... ... ... ... ... ... 290

METALLURGICAL TOPICS—
Decomposition of Austenite in 12 per cent Manganese Steel. (Illus.) ... 300
Titanium Tubing ... ... ... ... ... 300
Hot Pressure Bonding of Metals ... ... 301
Transformer Steel. (Illus.) ... ... ... 303

CONTINENTAL SECTION—
Development of the Grand Canal D'Alsace : The Stages Fessenheim and Vogelgrün. (Illus.)... ... ... 322
Railway Bridge at Essen Station. (Illus.) 326

AMERICAN SECTION—
U.S. Army Package Power Reactor in Virginia. No. II. (Illus.) ... ... 327
American Pump Turbine for Brazil ... 329
Joint American-European Atomic Energy Firm ... ... ... ... ... 329
Automatic Control of Machine Tools by Magnetic Recording Tape ... 329

LETTERS AND LITERATURE ... ... ... ... 302

LETTERS TO THE EDITOR—
Standards for the British Automobile Industry ... ... ... 302
Fairground Tunnel Railway ... ... 302

BOOK REVIEWS ... ... ... ... ... 302

OBITUARY—
Sir Cyril Kirkpatrick ... ... ... ... 303

NEWS AND NOTES—
Advanced Engineering Courses ... ... 332
British Patent Specifications. (Illus.) ... 331
Catalogues and Brochures ... ... ... 332
Forthcoming Engagements ... ... ... 332
Industrial and Labour Notes... ... ... 321
Launches and Trial Trips ... ... ... 332
Personal and Business ... ... ... ... 330

## LOW'S CARTHORSE SPEAKS

Each year, about this time, when we read the report of the General Council of the Trades Union Congress, we chuckle once more at Low's, the cartoonist's, inspiration in representing the T.U.C. as a carthorse. For the report of its General Council has all the attributes of that animal. It represents the considered opinions of a weighty and powerful section of the community and it has a ponderous, slow-moving dignity all of its own. No sparkle of wit enlivens it ; no shaft of humour is allowed to intrude. Levity, it is clearly felt, would be out of place. Even when governmental policy is under fierce attack there is not a trace of humanly understandable malice. Life is so solemn and earnest that those who compile the report hardly seem conscious that they may be biased and self-seeking in assuming that what would be good for trades unionists would necessarily be good, too, for the community at large. Governmental White Papers are usually serious enough. But by contrast with the report of the General Council they are light and airy reading ! Indeed, one does not read the report. A more ponderous, a more dignified term is required. One studies it, preferably with deep attention.

With a Conservative Government in power it is natural to think of the General Council as perpetually in opposition. It would be easy to assume that, like the Socialist Party under the same circumstances, it will be bound to be deeply critical of anything and everything the Government proposes or does. But, in fact, these annual reports reveal a very different attitude. The trades unions, despite their political allegiance to socialism, claim to be non-political in character, and over wide fields of human endeavour the annual reports do show them to be thinking along lines that are not party political. Unlike the leaders of the Socialist Party the members of the General Council see no virtue in scoring a debating point. Indeed, in the context of so solemn a document as the report, the making of a scoring point would read like a scurrility ! Of course, the Government comes under criticism. But it comes under criticism whatever its political complexion. For the T.U.C. is a " pressure group " anxious to see certain things done as soon as possible, so that, even if the Government is moving in a desired direction, it is likely to be criticised for moving too slowly. The present report, for example, " welcomes " developments in technical education since the 1956 congress was held, but emphasises that " the expansion of higher technological education " can only be successful " if based upon a substantially improved quality of technical education at lower levels," which is also required " in the interests of the training of craftsmen and technicians." Few, at least amongst engineers, will be disposed to disagree. The same, by no means unwelcome, tendency to press for more rapid changes is to be found, a little unexpectedly, in the Council's comments on technological development. " Both industry and the community have more to fear from too slow rather than too fast technological—including automation—developments." Would that the same view was as firmly held at lower levels of the trades union hierarchy ! In other fields the Council is concerned less to criticise than to inform the Government. Had the General Council been a party political body it could have made an issue of the Government's proposal to link this country into a Free Trade Area around the European Common Market. A motion proposed by the Union of Jute Flax and Kindred Textile Operatives for presentation to the congress proposes that, should the Free Trade Area come into being, protection for the jute industry should be continued. No doubt there are other unions similarly opposed to free trade. Had the Council expressed opposition to the Government a fine party political issue might have been made of the affair. But, in fact, the Council has made no such issue of it. Instead, it has stressed to the Government the importance of certain factors which will need to be clarified in negotiating the Free Trade Area, in particular that all countries concerned shall be required to adopt policies leading to " a high and stable level of employment." No doubt this responsible attitude will influence the policy eventually adopted by the Socialist Party. But, let there be no mistake about it, criticism, when the Council feels it is called for, can be sharp. The " dilatory attitude " of the Government towards the problem of Britain's roads leads to the use of language hardly less outspoken than that which the Council uses to condemn Tory economic policies. Like other bodies, the Council, when it made " vigorous representations " to the Government, received the reply that " future developments had to be decided

in the light of what could be afforded." Does there lurk in the Treasury, we wonder, some idea that good roads are a luxury, that only plutocrats in expensive cars roll over them, and that expenditure upon them is anti-social in these egalitarian days ? For only upon some such premise can the argument that the country cannot afford good roads be sustained. Now that the T.U.C. has added its voice to that of industry dare we hope for more energetic action?

Only when it comes to study conditions of work, wages and economic factors does the Council become solidly partisan. On such matters the Council becomes not irresponsible, but blind to the strength of any view other than its own. Balanced assessments of national needs go by the board. No doubt, it should be so. The T.U.C. represents the workers, not executives, professional men and industrialists. But it is much more important to note over how wide a field, as demonstrated by the General Council's reports, there is near-unity between the views of industry and the trades unions, than to stress divergencies. The carthorse may wear economic blinkers and be inattentive to the national reins, but, on the whole, it wants to go where the industrial cart is best taken !

### TECHNOLOGY AND WISDOM

The extension, all over the country—and, indeed, all over the world—of facilities for advanced technological education carries with it a sense of alarm. This arises not from any failure to realise the need for increasing the number of competent technologists, but from an impression that we may be overlooking the paramount need for preserving and strengthening not only values of character and culture, but that curiosity and originality which, in the past, has flowered in our workshops and in technical rather than technological schools. Again, while technology is ever advancing, wisdom is apt to remain static. " Knowledge comes, but wisdom lingers," and we do well to remember the words of Churchill in that place where he tells us how " The first duty of a university is to teach wisdom not a trade; character, not technicalities." Writing some months ago on this same theme, Professor Coulson remarked that " Bigger and better scientific laboratories do not necessarily make for world peace or a harmonious balanced life ; a more extensive knowledge of electronics and metallurgical technique does not necessarily mean a mature judgment or a satisfying personality." It is very true, and we stand urgently in need of such a system of selection and of basic education as shall ensure the entry of candidates endowed with the requisite qualities. These must include, along with intellectual capacity, the human attributes imperative in leadership.

It is futile to suppose—as apparently some among us do—that the current and prospective expenditure of vast sums on buildings, equipment and teachers will necessarily result in establishing a stream of original thinkers or first-rank research students. Let us not forget that " Epistle to the Reader " which John Locke annexes to the " Essay Concerning Human Understanding." " The commonwealth of learning (he writes) is not at this time without master-builders, whose mighty designs in advancing the sciences will leave lasting monuments to the admiration of posterity ; but everyone must not hope to be a Boyle or a Sydenham, and in an age that produces such masters as the great Huygenius, and the incomparable Mr. Newton, with some other of that strain, it is ambition enough to be employed as an under-laborer in clearing the ground a little, and removing some of the rubbish that lies in the way to knowledge." Speaking in January last before a conference of school masters at Oxford, Mr. R. Peddie, secretary of the United Steel Companies, pleaded for a " less specialised and more liberal education for scientific recruits to industry." Among other things, Mr. Peddie is reported to have remarked that " Many of the products of our universities seem to have acquired the facility to absorb a vast amount of detailed knowledge. But they do not seem to have acquired the ability to relate this knowledge to external affairs. They have a great deal of factual knowledge. But they seem to have no originality of ideas, very little interest in matters outside their own particular field, very little enterprise, and often very limited ambitions. . . . What are you doing to them ? I wonder whether you have filled them with so much learning that you have killed their sense of curiosity ? " Surely it is impossible to stress too strongly the importance—in technologists or technicians—of what Mr. Peddie calls the " sense of curiosity."

Thomas Jefferson—himself a man of wide scientific knowledge, a classical scholar and the founder of the University of Virginia—is on record as having valued good humour "more than all things." In a letter written while President of the United States, he places the qualities of the mind in the following order :—(1) Good humour, (2) integrity, (3) industry, (4) science. Writing to Joseph Priestley on the value, in university education, of Greek and Latin, Jefferson remarks, " I do not think them essential to the obtaining eminent degrees of science ; but I think them very useful towards it." Jefferson and Priestley were men to whom science without culture and humanity was sheer barbarity. Nothing would have better pleased them than that inscription carved on the façade of the main hall of Perth University, Western Australia, which tells the visitor how the building was erected " To further the advancement of learning and the ennoblement of life." The history of the twentieth century has not, up to date, encouraged us to believe that human nature necessarily grows better under the influence of what is called civilisation, since the first half of the century witnessed unparalleled scientific progress accompanied by mass barbarities surpassing the excesses of the sixteenth century. In such circumstances, we shall do well to remember the cautionary words of the Rouse Ball Professor of Mathematics at Oxford, who, in the letter from which we have already quoted, relates how, on a recent visit to the Massachusetts Institute of Technology, he was " interested to see right in the middle of the campus site a first-rate theatre and a chapel. Is there not here (he continues) a clue we might follow? If we concentrate solely on our technology we may even do harm (there is evidence that both on the Continent and in America it is the student of technology who is most easily misled by political catch-phrases)." Cicero maintained that the greatest gift which could be offered to the State was to train youth and we may devoutly hope that in the new technological establishments now being created throughout the country, the development of character and culture shall proceed concurrently with the teaching of mathematics and science.

## The Engineer
### 100 Years Ago
(AUGUST 28, 1857)

" METROPOLITAN CENTRAL TERMINI "

" Perhaps one of the grandest schemes of the railway mania period of 1845–6, was that for the Great Central terminus, which was to unite all the lines north, south, east, and west of London into one great system. By it a man from Farringdon-street could have reached any portion of the wide world. . . . From the report of the Metropolitan Railway Company, presented to the shareholders at the last half-yearly meeting, it appears that the royal assent has already been given to a bill extending the powers of the company for another year, giving it time to renew its applications to the different companies supposed to be interested in the undertaking. It seems that up to this time, no favourable answer has been received either from the Great Northern or the Great Western Companies ; indeed, far from this, the Great Western Company have positively refused to have anything to do towards contributing to the undertaking. . . .

" That some scheme will eventually be carried out for the more ready conveyance of passengers to the principal termini, there can be no doubt, and we are glad that the Metropolitan Company have succeeded in their application to Parliament for an extension of time, as, in another year, we may possibly see some persons disposed to invest in such an undertaking, which, if frugally managed, we believe must be remunerative. . . . In our opinion the existing companies are not likely to contribute towards any new schemes, especially through expensive districts. The passengers benefitted by any metropolitan lines must pay for the accommodation, and the fares must not be merged in those of the great lines if they are to be made remunerative."

### THE L.C.C.'s NEW TOWN

It was recently announced that the Government has agreed, in principle, to the idea of the London County Council itself developing a new town. The Council has advocated this course for some time, so that a new town might be created " specifically planned for receiving overspill from the County of London." No site has yet been chosen, nor any special arrangements made for financing the project, which the L.C.C. estimates might cost £50,000,000, spread over ten years, if a town of 60,000 people is envisaged.

Pressure for new buildings—housing and other classes of building as well—is evidently highest in and around London. Already most of the new towns cluster round the metropolis, and in spite of all the planning expedients so far devised, it is becoming increasingly difficult to retain much of the rural and agricultural nature of the home counties, where they border on Greater London, or where there are centres connected with central London by fast train services. In the past the L.C.C. has grappled with this situation by creating large housing estates in outer areas. The present approach, aiming at a complete new town, seems a far better one and, judging from the L.C.C.'s recent architectural achievements with " point blocks " of flats interspersed with smaller buildings on large housing sites, it would appear that the L.C.C. will make a good job of the architectural layout of its new town. Thus, if it is essential to " overspill " Londoners into other surroundings, then the L.C.C.'s idea of a new town seems to be the best one. The sociological and even political aspects of this policy are, of course, debatable, but the L.C.C. has had a housing problem for many years and presumably the experience thus gained would indicate that a proportion of Londoners have no objection to being " overspilled."

We can only hope that the high standard of planning shown in these matters by the L.C.C. might also show itself in the future in the planning of modern roads in the London area. A progressive attitude towards motor traffic in urban areas—especially London—is at the heart of all these planning problems. A skeleton of efficient urban highways added to the basic services—railways, main drainage, and so on—already in existence, forms an essential basis for satisfactory planning in London. With this background, the other problems of planning would fall into perspective, and be more easily soluble. One of the incidental benefits of good road communications in London would be an easing of pressure on housing which might well outweigh the effect of a new town.

# A Seven Day Journal

### Aircraft Problems

SPEAKING in London last Tuesday, Sir Matthew Slattery, chairman of Short Brothers and Harland, Ltd., discussed some of the problems with which the aircraft industry was at present contending. His firm had invested in tooling and plant to enable it to build Bristol " Britannia " turbo-prop airliners at a rate of one a week, although there was at present no prospect of such a rate of production being justified by orders for the machine. The actual building of an individual aircraft, assuming no delay due to late delivery of materials or components, occupied fifteen months, so that that time represented an irreducible minimum in which additional capacity could bear fruit. He observed that, because of this long time-constant in the production cycle, the Bristol Aeroplane Company was, a year ago, building aircraft for stock, and in so doing had risked sums of the order of their issued capital.

Sir Matthew also gave some details of the progress of the Short " S.C.1 " research aircraft, inspired by the proposals of A. A. Griffith for vertical take-off. Two airframes had been built, although only one set of engines was to be provided ; the lift engines had now been received at Belfast and the aircraft would shortly commence hovering trials, tethered in a gantry composed of Bailey bridge elements. Progress was slow on this project simply because it was financed sparingly by the Ministry of Supply, and, for example, work was confined to normal hours. He admitted that lack of expedition in fundamental research endangered the future of an aircraft industry currently earning £100 million per year, but pointed out that Short Brothers was 70 per cent Government owned and unable to raise further capital.

### The Radio Show

As a shop window for Great Britain's television, radio and sound reproducing equipment, the Radio Show, which opened at Earls Court on Wednesday last, appeals mainly to the layman. This year, for example, he notices a continued trend towards sets with larger television screens. The 17in size is still in the majority but more sets are being built around the 21in screen and without any marked increase in overall size. Compactness is achieved mainly by the use of wide-angle screens with 90 deg. beam deflection and with a reduction in the front-to-back length of the tube. To exploit this gain fully many makers have reduced the size of the cabinet by economising in the frontal framing of the screen and in the space occupied by components. Trends such as these are likely to be accelerated by the growing use of transistors and printed circuit techniques, but at present the main outlet for these techniques is in midget radio sets and miniature portable television sets, some examples of which are to be seen at this year's show. An interesting novelty is a very small radio set incorporating transistors and a " solar battery " made up of photo-sensitive cells. Transistors are also to be found in an increasing number of hearing aids. A new commercial application of closed circuit television principles is a two-way visual and aural communication system whereby facsimile images can be reproduced in line or half tone (from transparencies and 35mm film strip, &c.) on the screens of special television-type cathode-ray tubes. The system uses " flying spot " scanning techniques and the visual information to be transmitted and received can be " mixed " and filtered to give considerable operational flexibility. The master and slave units in such a circuit are connected by coaxial cable and transmission can be up to 2000 yards without amplification.

### International Commission on Irrigation and Drainage

THE British national committee of the International Commission on Irrigation and Drainage has published a booklet describing the activities of the Commission, and in particular of the British section. The aim behind this publication is to increase British participation in the Commission's affairs. The leading part played by British civil engineers over the past 100 years or so in the creation and operation of vast irrigation systems and the river control works which serve them in India, Pakistan, Egypt, Ceylon and the Sudan is stressed, and the booklet goes on to point out that less spectacular but nevertheless substantial improvements in land drainage have also been effected in this country, particularly during the last twenty-five years. The fund of British knowledge and experience thus acquired is valued by numerous countries now engaged on works of this nature. Increase of food production is now a prominent aim, and thus irrigation and drainage projects are likely to increase ; possibly twice as much large-scale engineering work will be needed for irrigation and drainage in the next fifty years, as was completed in the last fifty, according to one estimate. Such a situation, it is pointed out, can hardly fail to be of importance to British manufacturers, soil scientists and consulting engineers.

### A Thorium Zero-Energy Reactor

IT is reported that an experimental zero-energy reactor, using thorium as fuel, is to be built at Winfreth Heath, Dorset. An announcement by The General Electric Company states that it has been awarded the contract for the work. The reactor is expected to provide information on the properties of thorium, and is intended for operation at high temperatures produced by external heating. The conditions obtaining in large reactors will be reproduced to some extent so that, although little power will be generated by the experimental installation, useful data are hoped for on the application of thorium in future nuclear power stations. The announcement follows on the U.K. Atomic Energy Authority's annual report, recently issued, in which it was stated that high priority is being given to the development of a thermal breeder reactor working on the uranium-233/thorium cycle. The cycle depends on the presence of fissile uranium-233 in the core ; neutrons released in its consumption are captured in thorium, which is transmuted to uranium-233. It is planned to use uncanned fuel able to withstand temperatures of the order of 800 deg. Cent. High thermodynamic efficiencies and

low fuel costs are aimed at. It is hoped that the experimental reactor will come into operation in 1960.

### Oil Hydraulic Circuitry

IT has been observed that while the units of oil hydraulic gear are progressing in design, the pipework coupling them is advancing much more slowly and understanding of the problems involved is imperfect. In order to ameliorate the present situation, in which use is made of " mystic numbers," such as maximum bulk fluid speeds, a rig for measuring flow and loss characteristics of pipe fittings has been made available at the Mechanical Engineering Research Laboratory. The rig can provide flow rates up to 250 gallons per minute at pressures up to 800 lb per square inch with oil of two viscosities, and at closely controlled temperatures for power dissipations up to 150 h.p. It is hoped by the laboratory that the conduct of a large proportion of all research on one plant may lead to all results being presented in the same form, and manufacturers interested in hydraulic piping are invited to send engineers to the laboratory to carry out experiments with the rig on their own fittings. This use of the rig will not only, it is hoped, be of advantage to the users but also afford valuable contacts to the research staff and lessen the work of the laboratory. Applications for this facility may be made to the Director, M.E.R.L., East Kilbride, Glasgow.

### Model Engineer Exhibition

THE *Model Engineer* Exhibition was opened at the New Horticultural Hall, Westminster, last week by the Earl of Northesk, the president of the Society of Model and Experimental Engineers. As in previous years, this exhibition shows the very wide field of interest the model has in all branches of industry and transport, and indeed how the enthusiast is prepared to turn his attention to practically any article of which a replica can be made as a working miniature providing it presents a challenge to his skill and ingenuity. The exhibition also includes a number of attractions designed to show the performance of some classes of the more spectacular models, such as miniature racing cars, ships and aircraft. A demonstration area has also been set aside and equipped as a model-making shop, perhaps more elaborately equipped than that of a majority of amateur model makers, but nevertheless providing useful guidance for the beginner. A feature of this exhibition has always been the way in which the large number of experienced model makers present are only too willing to give full details of the way in which they overcome problems of design and manufacture to those interested, and there is a vast fund of information available to the beginner at this demonstration area. It is of interest to note that this year work is shown of modellers ranging in age from eight to eighty-eight years, and individual models range in value from 5s. to £750. The standard of workmanship is invariably very high and no engineer used to a fully equipped workshop can fail to admire the ingenuity, skill and patience with which precision work has been carried out, often with a minimum of somewhat crude tools.

# Performance and Efficiency Tests on B.R. Class "8" Locomotive

By O. S. NOCK, B.Sc., M.I.C.E., M.I.Mech.E., M.I.Loco.E.

No. II—(*Concluded from page* 261, *August* 23)

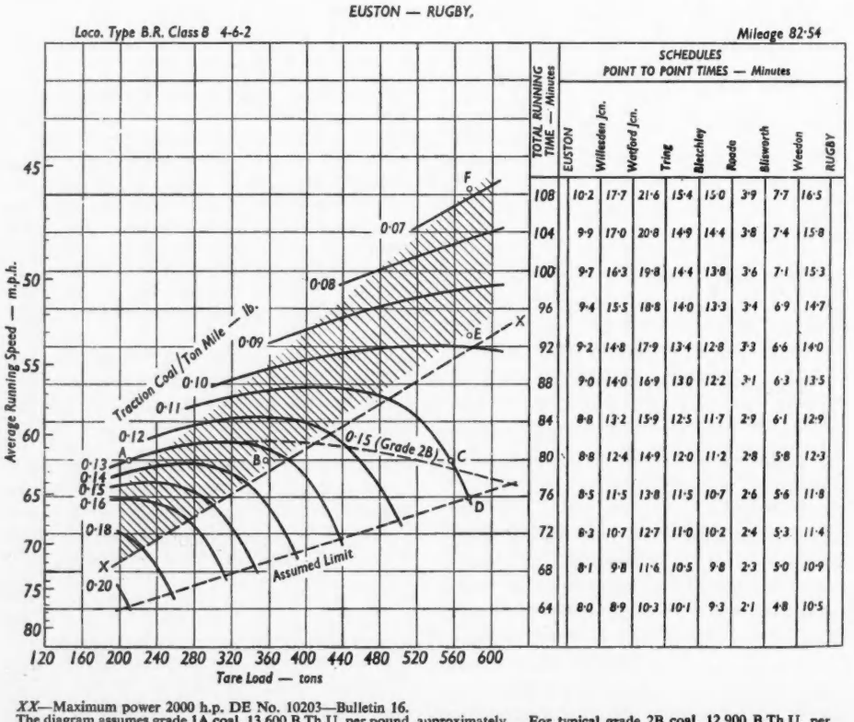
*In last week's article the author commented upon the basic performance characteristics obtained on stationary tests with this locomotive. In the present article controlled road tests are discussed, and the application of results to train services over the London Midland main line commented upon. There is also a reference to improvements made to the Western Region " King " class engines, as a result of Swindon testing experience with the B.R." 8 " engine.*

THE controlled road tests conducted with the B.R. " 8 " locomotive were unusually comprehensive in the amount of high speed and slow running involved, all at a constant rate of evaporation. Instead of the usual test course followed with locomotives under examination by the Swindon locomotive testing station, namely between Reading and Stoke Gifford, the trials were conducted between Marston Yard, 3 miles east of Swindon, and Westbury. This provided a fast run on the Bristol main line as far as the western approaches to Reading ; some slow running over the junctions at Reading West, Oxford Road and Southcote, and then a renewal of normal express speed, over the so-called " Berks and Hants line," through Newbury and Savernake. Even this section, however, included some stretches where a moderate restriction of speed was necessary. The steam rate was kept constant during all periods of restricted speed, by adjustment of the reverser, in conjunction with use of the brakes, even down to the speed of 15 m.p.h.

In Fig. 12 is reproduced part of a controlled road test on which the steam rate was 30,000 lb per hour, and the coal rate 4850 lb per hour. It shows a stretch of fast running at a speed of nearly 80 m.p.h. on a slight descending gradient ; the heavy slack to 15 m.p.h. for Reading West junction, and subsequent running up the " Berks and Hants line " as far as Newbury. This again includes a brief period of braking, in order to reduce speed to the stipulated maximum of 60 m.p.h. at Midgham. The gradients are shown in diagrammatic form at the top of the diagram, not to any vertical scale, but to indicate the actual slope and whether rising or falling over the length in question. It will be noted that when running towards Reading the test train was meeting an adverse wind of approximately 10 m.p.h. On another occasion when the weather was calm the same steam rate produced considerably higher speed with a train load of 610 tons, against 586 shown in Fig. 12. Between Challow and Pangbourne, 22·4 miles, the average speed was 81·4 m.p.h., as compared with 78 m.p.h. on the test shown in Fig. 12. Both runs are enough to show, however, in the most spectacular way, the free-running capacity of this locomotive with heavy trains.

### THE CRITERION OF FUEL ECONOMY

The bulletin deals at some length with the economy of engine performance, and while the actual data discussed relates, of necessity, to no more than one locomotive, of a type that is not likely to be multiplied, the principles involved are fundamental, and of much




*XX*—Maximum power 2000 h.p. DE No. 10203—Bulletin 16.
The diagram assumes grade 1A coal, 13,600 B.Th.U. per pound approximately. For typical grade 2B coal, 12,900 B.Th.U. per pound approximately, increase the coal per ton miles by 13 per cent and 20 per cent at the lower and higher boundaries of the hatched areas, respectively, and by 40 per cent at the assumed limit.

**Fig. 11—Cost of energy and performance, Euston to Rugby**

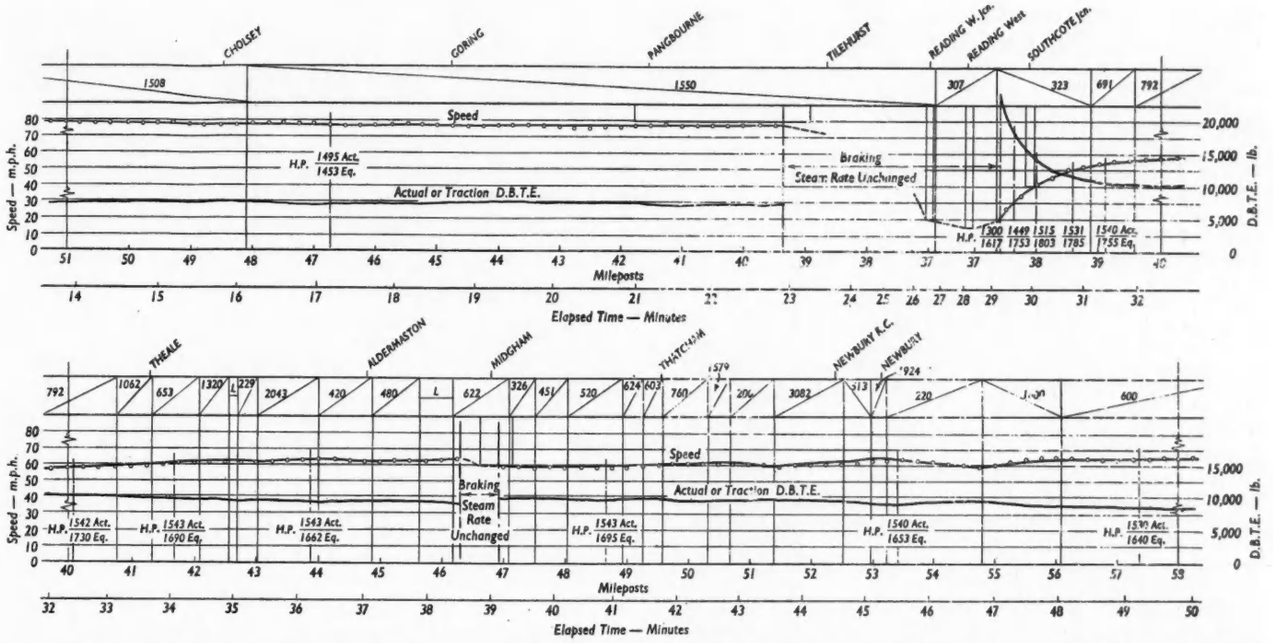



**Fig. 12—Part of controlled road test at a constant rate of steam production and utilisation of 30,000 lb per hour—coal rate 4850 lb per hour—load 586 tons passenger stock**

interest in relation to future locomotive power developments in this country. The criterion of fuel economy is the amount expended per ton mile. But in the haulage of passenger trains the paying load bears so little relation to the locomotive effort involved that the coal per ton mile must be related, for the most part, to the trailing tare load. Even this can be misleading, due to the variations in passenger loading experienced from time to time, and the variations in make-up of different trains. For example, 500 tons tare would involve a considerable difference in gross trailing load with a crowded sixteen-coach holiday train, carrying almost exclusively second-class passengers, to that of a train like the 10.20 p.m. from Glasgow Central to Euston, which is confined to sleeping-car passengers only. In the former case the increment of gross over tare load would be 65 to 70 tons, while in the latter it would be 30 tons at the very most. With schedules based upon the trailing tare load the discrepancy could lead to the overloading of a locomotive and consequent loss of time ; though generally speaking the schedules laid down for trains of the former category include a good deal of " recovery time," and are not planned so near to the normal maximum capacity of locomotives as regular business trains, the passenger loading of which is well known.

In Fig. 11 is shown a " Cost of Energy and Performance " diagram for the B.R. " 8 " " Pacific" engine relating to the non-stop run of 82·6 miles from Euston to Rugby. The values have been calculated from the basic performance data obtained on the Swindon tests, in due consideration of the physical characteristics of the line. The point-to-point times aggregating to the various total running times shown in the central vertical column have been calculated on the basis of a constant evaporation throughout. In this table particular interest is attached to the overall schedule of 80 min from Euston to Rugby ; this is actually booked all the year round with the " Midday Scot, " and during the winter months with the " Royal Scot. " Both these are heavy trains, loading to 450 tons tare, or more, and it is interesting to observe how actual running times made by expert drivers compare with the theoretically derived values shown in Fig. 12. The following table shows summary details of four journeys made with class " 8 " " Pacific" engines, and loads in excess of 450 tons tare. Where delays occurred on the service runs allowance has been made in the times tabulated so as to render the workings comparable. Of the locomotives concerned No. 46201 is of the earlier Stanier type having the same nominal tractive effort as the later " Duchess " series, but considerable less boiler capacity.

*Euston-Rugby : 80 min Schedule*

| Engine No. / Engine class / Load tons, tare | Miles | Schedule from B.T.C. Bulletin | 71000 B.R. "8" 453 | 46201 L.M. "8" 455 | 46231 L.M. "8" 474 | 46248 L.M. "8" 475 |
|---|---|---|---|---|---|---|
| | | Point-to-point times—minutes | | | | |
| Euston | — | — | — | — | — | — |
| Willesden Junction | 5.4 | 8.8 | 9.3 | 10.4 | 10.5 | 10.8 |
| Watford | 12.1 | 12.4 | 12.2 | 12.2 | 11.0 | 11.6 |
| Tring | 14.2 | 14.9 | 13.0 | 13.4 | 12.6 | 13.5 |
| Bletchley | 15.0 | 12.0 | 12.2 | 12.1 | 12.0 | 11.9 |
| Roade | 13.2 | 11.2 | 10.8 | 11.1 | 10.8 | 10.8 |
| Blisworth | 2.9 | 2.8 | 2.5 | 2.7 | 2.4 | 2.4 |
| Weedon | 6.9 | 5.8 | 5.4 | 5.8 | 5.4 | 5.2 |
| Rugby | 12.9 | 12.3 | 13.0 | 13.3 | 12.2 | 12.0 |
| Total | 82.6 | 80.0 | 78.5 | 81.0 | 76.9 | 78.2 |
| Aggregate time to Weedon | 69.7 | 67.7 | 65.5 | 67.7 | 64.7 | 66.2 |

The bulletin analyses the 80 min Euston-Rugby timing with respect to the various factors affecting the coal per ton mile, and on the basis of performance of the B.R. " 8 " engine, some most interesting figures are tabulated, relating to the maintenance of the schedule with trailing tare loads of 210, 357 and 556 tons. From a larger table in the bulletin the following details have been extracted :

*Euston-Rugby : 80 min Schedule*

| | | | |
|---|---|---|---|
| Tare load, tons | 210 | 357 | 556 |
| Gross trailing load (tare plus 10 per cent), tons | 231 | 393 | 612 |
| Gross weight, tons | 388 | 550 | 769 |
| Coal per ton mile, pound | 0·13 | 0·133 | 0·11 |
| Coal per mile, pounds | 27·3 | 47·4 | 61·1 |
| Steam rate, pounds per hour | 16,000 | 24,000 | 28,300 |
| Coal rate, pounds per hour | 1,805 | 3,040 | 4,000 |
| Traction drawbar horsepower (average) | 532 | 1,125 | 1,500 |
| Estimated coal per drawbar horse-power-hour, pounds | 3·5 | 2·86 | 2·79 |

The point that immediately strikes one's notice is the difference between the theoretical and the actual starts. The B.R. " 8 " engine got nearest to the theoretical 8·8 min from Euston to Willesden, but the London Midland 4–6–2s were all nearly 2 min " down " at the first timing point. Practical considerations enter into the working. Quite apart from a natural reluctance of drivers to pound their engines over the first miles of a long and strenuous run there is the risk of slipping on the 1 in 77 gradient of Camden Bank, and again in Primrose Hill tunnel. In consequence, the effort has to be increased after Willesden. There is also a reluctance to approach a large centre such as Rugby working at the limit of brake power, and the majority of drivers ease off well before the station is closely approached.

This table emphasises the severe nature of this booking, seeing that even with a good basic coal consumption of 2·86 lb per drawbar horsepower-hour the coal per train mile is as high as 47·4 lb with a tare load of 357 tons. With the trains of 450 to 470 tons tare regularly worked on this service it would appear from observations on the footplate that the coal consumption of the " Duchess " class engines is somewhat lower than that of the B.R. " 8," and it will be interesting to compare the basic test results for the two classes when the bulletin comes to be published for the engine of the former class that was on test at Rugby at about the same time as the B.R. " 8 " was on test at Swindon.

### Carnforth–Carlisle Schedules

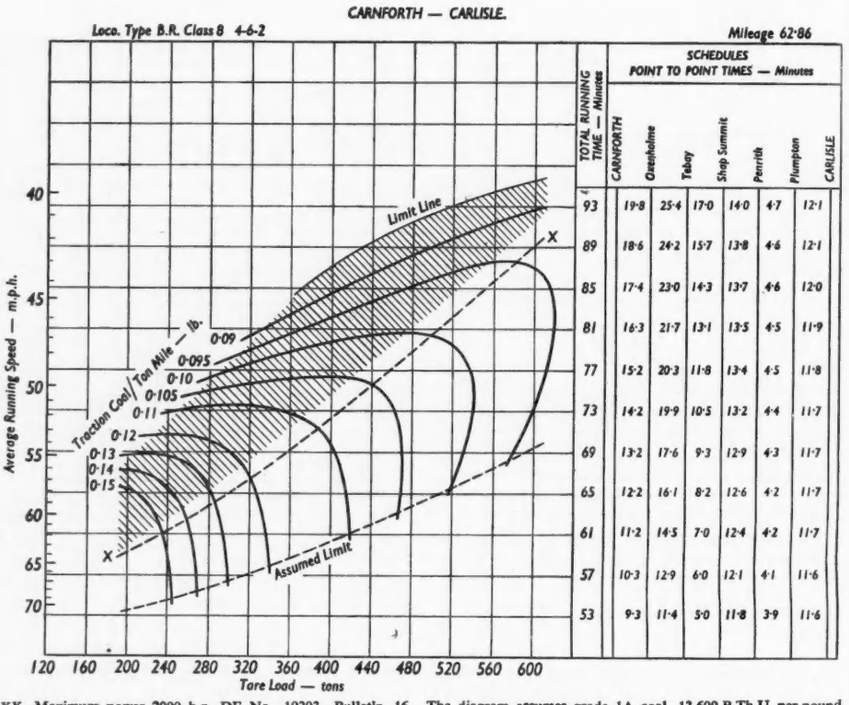
The predicted details of performance over the London Midland line become of still greater interest when applied to the heavier road between Carnforth and Carlisle. Between Euston and Rugby, except at the start, actual running corresponds very fairly with theoretical timings. It could, on the other hand, be argued that the closer timings are to the maximum capacity of a locomotive the

nearer will be the working to a constant rate of evaporation. There is no chance for a "let up"; the boiler must be steamed uniformly hard throughout. The gradient profile of the line between Carnforth and Carlisle is shown in Fig. 13 and the "Cost of Energy and Performance" diagram is shown in Fig. 14. The principal difference to be observed in comment upon this diagram, in contrast to that relating to the Euston-Rugby section, is that the locomotive can be steamed hard for no more than half the distance. On the steep descent between Shap Summit and Carlisle very light steaming is necessary to keep the train running at the highest speeds desirable over this road, and the only sections where a steam rate equal to that used on the ascending side can be used are in accelerating from Shap Summit to a speed of 70 m.p.h. or so, and once again in accelerating from the speed restriction imposed through Penrith.

The point-to-point times and speeds observed in ordinary traffic are as much a measure of the individuality of the driver as of the thermodynamic or physical characteristics of the locomotives. Some drivers, no matter how late they may be running, or how excellent the machine in their charge, will never—it seems—take advantage of the long falling grades. Others might moderate their downhill speeds with a rough engine, while yet a third category descends like a thunderbolt whatever the locomotive is at their command. But one frequently notes considerable variations on the uphill stretches; anything approaching a constant rate of evaporation does, indeed, seem rare.

In the accompanying table the theoretical point-to-point times for a run of 73 min, pass to stop, are shown against details of four actual journeys, when the overall time was similar.

The variations in driving practice to be noted over this route could not be exemplified better than by comparison of the work of engines No. 46227 and No. 46237. Both engines passed Carnforth at 72 m.p.h., after which No. 46237 fell steadily behind on the climb to Grayrigg. This latter engine might have kept the B.T.C. point-to-point time from Oxenholme to Tebay had not the driver practically shut off steam after Low Gill (see gradient diagram, Fig. 13) and commenced the ascent of the Shap Incline at no more than 53 m.p.h. On the comparison run No. 46227 worked up to 70 m.p.h., "charged" the Shap Incline, and made a fast time to Summit even though speed eventually fell to a lower minimum than registered on the run with No. 46237. The latter engine was then taken at unusually high speed down to Carlisle. The large modern "Pacific" engines are, however, very prone to slipping on the steep gradients at times of inclement weather, and driving technique of the kind displayed with engine No. 46227 between Tebay and Shap Summit is sometimes used to avoid the necessity of long cut-offs and hard pounding, which might give rise to slipping. There are, indeed, many local icrcumstances that influence train working over a route such as that between Carnforth and Carlisle, and give rise to wider variations between theoretical and actual point-to-point times than are seen on routes of more even grading.




*XX*—Maximum power 2000 h.p. DE No. 10203—Bulletin 16. The diagram assumes grade 1A coal, 13,600 B.Th.U. per pound approximately. For typical grade 2B coal, 12,900 B.Th.U. per pound approximately, increase the coal per ton miles by 13 per cent and 20 per cent at the lower and higher boundaries of the hatched areas, respectively, and by 40 per cent at the assumed limit.

**Fig. 14—Cost of energy and performance, Carnforth to Carlisle**

*Carnforth-Carlisle : 73 min Schedule*

| Engine No. / Engine class / Load, tons tare | Schedule from B.T.C. Bulletin | 71000 B.R. "8" 437 | 46227 L.M. "8" 491 | 46237 L.M. "8" 497 | 46234 L.M. "8" 514 |
|---|---|---|---|---|---|
| | Miles | Point-to-point times, minutes | | | |
| Carnforth | — | — | — | — | — |
| Oxenholme | 12·9 | 14·2 | 12·3 | 13·0 | 14·3 | 14·8 |
| Tebay | 13·1 | 19·0 | 15·2 | 18·4 | 19·8 | 18·5 |
| Shap Summit | 5·5 | 10·5 | 9·5 | 8·9 | 10·4 | 9·2 |
| Penrith | 13·6 | 13·2 | 12·3 | 14·6 | 12·6 | 12·9 |
| Plumpton | 4·7 | 4·4 | 4·6 | 5·2 | 4·0 | 4·3 |
| Carlisle | 13·1 | 11·7 | 12·5 | 13·8 | 10·8 | 12·6 |
| Total | 62·9 | 73·0 | 66·4 | 73·9 | 71·9 | 72·3 |

L.M. "8" locomotives are all "Duchess" class

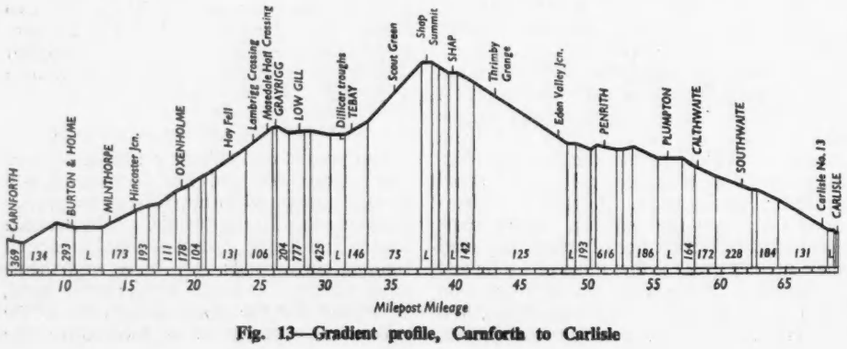



**Fig. 13—Gradient profile, Carnforth to Carlisle**

## Developments After the Tests

Although the B.R. "8" locomotive No. 71000 is the final development of the British steam express passenger locomotive and therefore of considerable historical interest, the devotion of so much time and care to the securing and analysing of test data might have been considered unnecessary in view of the impending substitution of diesel and electric power on the heaviest main line duties. But advantage has been taken of the experience gained in the testing of No. 71000 to improve still further the performance of Western Region steam locomotives. It was largely as a result of the good impression gained from No. 71000, and the London Midland "Duchess" class 4–6–2, that the decision was taken to modify the "King" class 4–6–0s still further, by the fitting of the double blast pipe and chimney. As a basis of comparison, the equivalent drawbar horsepower resulting from a firing rate of 3000 lb of coal per hour has been tabulated.

*Coal Rate 3000 lb per Hour*

| Engine class | "King" Improved draughting single chimney | B.R. "8" 71000 | "King" Double chimney |
|---|---|---|---|
| Steam rate, pounds per hour | 24,850 | 23,800* | 25,600 |
| Equivalent d.b.h.p.: | | | |
| At 60 m.p.h. | 1,135 | 1,300 | 1,250 |
| At 70 m.p.h. | 965 | 1,180 | 1,090 |
| At 80 m.p.h. | 735 | 990 | 865 |

* Using Grade 1A South Kirkby coal.

From the above it will be seen that on the "King" class engines the equivalent drawbar horsepower, for an equal coal consumption, has been increased by 10·1 per cent at 60 m.p.h., by 13 per cent at 70 m.p.h., and by no less than 19·5 per cent at 80 m.p.h. This valuable improvement can be traced directly to the successful working of the B.R. "8" engine. It will also be seen that although the "King" boiler produces a greater volume of steam per pound of coal fired, the higher cylinder efficiency of the B.R. "8" engine produces higher equivalent drawbar horsepower for the same weight of coal fired.

# Defensive Homing Missile

*A long-range semi-active homing anti-aircraft missile propelled by ram-jets, the Bristol "Bloodhound" can now be illustrated and, to some extent, described. It is part of a weapons system in production for the Royal Air Force and available to Commonwealth and N.A.T.O. countries.*

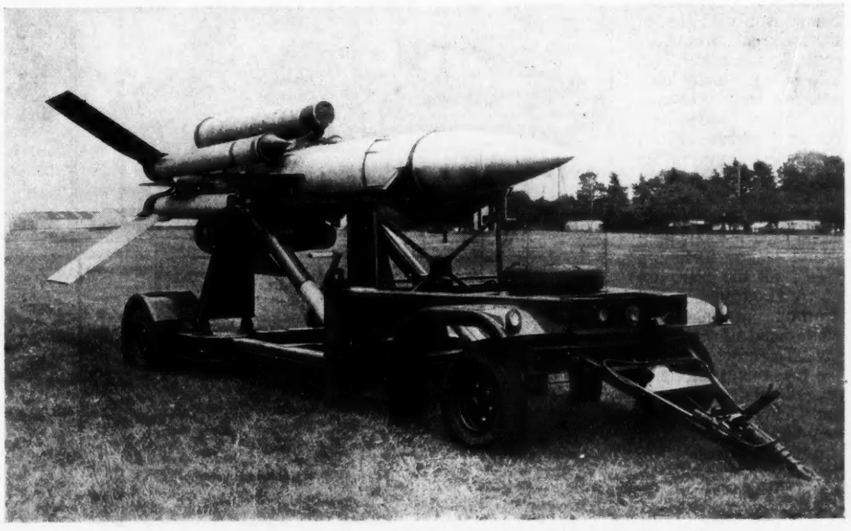
THERE have recently been disclosed some details of the Bristol "Bloodhound" surface-to-air missile, which is now in production at five factories in this country operated by the Bristol Aeroplane Company and Ferranti, Ltd.: it is claimed that the labour force engaged on the weapon is the largest on such a task in Western Europe. Work on the weapon system was commenced by Bristol in 1949, making it the newest of the first generation of British missiles, although it is one of the first to be to any extent declassified.

The system acts as follows: a long-range radar system first detects the approaching aircraft and passes the bearing and elevation of the target to the defenders, who aim an "illuminating" radar upon it. Details of the radar installations have not been made known, and it remains speculative whether the link between early warning and weapon radar is automatic or human. The weapon radar is range-finding, and the beam is narrow enough to enable two aircraft in formation to be attacked simultaneously. At a suitable time a "Bloodhound" is discharged on the bearing, in azimuth, of the target, and proceeds to home upon the target as "seen" by the reflections from the ground radar. The claim is made for the guidance that it can compute the optimum course for the shortest time of flight: this implies a highly refined intelligence and almost certainly requires the missile to intercept also the transmissions from the ground to provide a time base for range-finding. A suggestion of equipment for this purpose can be detected. The safety and arming devices, fuse, warhead, and self-destruction provisions cannot at present be described.

The general arrangement of the missile, which weighs of the order of 2000 lb, can be discerned in the illustrations. It is accelerated by four Bristol solid-propellant boosters, each with a very large swept-back fin of plywood covered in sheet metal, which are pivoted to a ring fitting into the back of the fuselage: when the total thrust of the boost appendages becomes less than their drag, they move backwards relative to the vehicle—the engines being assumed to have lit up—and the forward attachments become free. Small aerofoils on the front mountings of the rockets draw the noses out to bring the casings at right angles to the direction of flight, thus allowing separation to be rapid and devoid of interaction between vehicle and boosts: the ease of separation is, of course, one of the justifications for the high drag of wrap-round boosters. The vehicle proper carries a nose section and warhead, attached by a number of forward-facing screws running into the small fairings which can be seen round the body: these are more closely pitched in the plane of acceleration forces. The nose appeared to be a light alloy spinning, but this may not be the case on actual rounds since the homing receiver is probably in the nose. The fuselage is built of light alloy in the accustomed aircraft manner, mainly flush riveted, but with numerous screwed attachments. Just in front of each engine are two hinged access panels, and in the foremost bay there is a large cap which may well be a kerosene filler. The fuselage continues at full diameter to the front of the engine mountings, and is then a frustum of a cone to the tail, where it is hollow for access to services on the ground. The two "Thor" engines are mounted on shallow pylons near the intakes, with fairings filling part or in some cases all of the length of the gap between engine and body. At the rear end the ducts are located by a pair of pins running fore and aft, and allowance for expansion of the motor is of the order of $\frac{3}{4}$in. In the front of each engine pylon is an air intake for auxiliary services: this, like the main engine intake, is an oblique-shock inlet with a pointed centre-body.

The "Bloodhound" is a monoplane with wings of double wedge section mounted on pivots at the deepest point of the chord: the plan-form is remarkably evocative of the Miles M.52 as well as of such missiles as "Talos." The only other aerofoils are fixed stabilisers in the plane of the wing: these are rectangular in plan, parallel in section with leading and trailing edges straight tapered. There are no fins, the ram-jets presumably providing sufficient keel area aft. Control is by altering the incidence of each wing as required, a system which is expected to give the fastest possible response since it is not necessary to change the attitude of the vehicle before acceleration can be developed: it is probably expensive in control power, particularly as "twist-and-steer" is employed, but since the vehicle appears to be symmetrical it is probable that no more than 90 deg. of roll is ever demanded. The tail-plane may be required to operate in a severely disturbed wake, but its duty is probably fairly simple. Near the root the tail-plane has its trailing edge thickened, and this may be to accommodate a receiving aerial of very short wavelength. The aerofoils are fabricated and not solid, metal skinned and probably stiffened with a non-metallic core.

Little can be said of the functioning of the vehicle. The compressed air from the above-mentioned intakes is the major energy source, delivering fuel to the engines and hydraulic fluid to the flying control system: electricity supplies may be from accumulators. A typical hydraulic pump runs at 32,500 r.p.m. and draws 20 h.p. from a single-stage reaction turbine about 8in in diameter: 1500 lb per square inch is developed by a centrifugal impeller with four straight radial vanes about 4in in diameter. The shroud in which the impeller runs is free to rotate and actually idles at about half pump speed: assuming drag forces to increase faster than linearly with speed, it can be seen that this device improves efficiency. The pump has a non-return valve, possibly only for ground testing but probably because an accumulator is incorporated, and a hydraulic servo mechanism on the pump regulates output pressure by a butterfly valve in the air inlet. The fuel pump has a single stage impulse turbine running at 30,000 r.p.m. and able to deliver 45,000 lb per hour at 800 lb per square inch: this performance is perhaps three times greater than that of the hydraulic pump, and suggests that the two are in series, the air passing first through the impulse turbine and, after being further cooled in the reaction turbine, being in all probability allowed to pass aft inside the body, cooling electrical gear or the structure adjacent to the engines. The performance quoted for the fuel pump must be regarded as an occasional maximum, since the fuel carried on the vehicle would be exhausted in the order of one minute at the rate mentioned, and the ram-jet is used principally



**A "Bloodhound" on its transporter: it is seen raised for transfer to the launcher**

because of its ability to give long flight times. The engine fuel controls are able to sense air mass flow and regulate the fuel accordingly to maintain the design shock disposition at the intake : very rapid and wide variation in thrust is called for in order to maintain the required flight Mach number in manœuvres, and it was demonstrated on the test bed that this has been achieved, the response time being of the order of one to two seconds. (A surprising feature of this demonstration was an occasional shower of sparks at the outside of the exhaust stream.) It is now known that the streams of fuel seen running back down the centre body are composed of fluid which has exhausted its pressure in operating the fuel control device, situated within the centre body, and has therefore to be

**A "Bloodhound" on its launcher : immediately beyond the centre-body of the "Thor" can be detected one of the auxiliary intakes**

dumped : the use of a ring of holes prevents it affecting the symmetry of the flame.* Of the control gear nothing can be said : the gyroscopes coast during flight, implying that a certain period of preparation for flight is required.

The launcher is zero-length, short hinged legs supporting the front attachments of two adjacent boosters and the vehicle being held by the boost thrust ring. Through this ring pass, from the launcher, a screened electrical lead and three armoured flexible hoses, two for hydraulic fluid in and out and one for compressed air. The missile can thus be functionally checked without dismounting it. It is loaded in the horizontal attitude from a carrying trolley : a hydraulic ram then raises it to the firing position, dictated presumably by the need for the boosters to fall clear of the site, and the linkage below the launcher is pinned in the straight attitude. The launcher is rotated by a hydraulic motor on the turntable driving a pinion engaging an internal ring gear on the base. To the launcher can be fitted adaptors to enable the front and rear two-wheel bogies of a 3·7in gun carriage to lift and transport it. Missile and launcher are camouflaged dark green, and it is the intention that the missile can stand, uncovered except for the air intakes, for long periods.

* The "Thor" was described in THE ENGINEER, August 10, 1956, page 203.

# Radial Flow Machinery

*Two new examples of gas turbine technology feature radial flow components, in one case because of the practical advantages in a small turbine, and in the other because of the need for an easily matched characteristic on a single-shaft mechanical-drive engine.*

A FRESH example of the trend towards simple gas turbines offering lightness and compactness rather than efficiency is the Ruston "TE" engine of 430 b.h.p. This is of the classical Whittle conception with a single centrifugal compressor but a three-stage turbine ; it is unusual in having two plain bearings, set outside the turbine-compressor assembly.

The single-stage unshrouded centrifugal compressor gives 3·5 : 1 pressure ratio. Both the impeller and separate inducer are manufactured from high-tensile alloy steel or, alternatively, high-strength Martensitic stainless steel where corrosive conditions are expected. There is a single reverse-flow combustion chamber, burning distillate fuels.

The three-stage axial-flow turbine has unshrouded Nimonic 90 blades designed for equilibrium vortex flow, the blades being retained in the "fir-tree" slots by Nimonic locking strips ; all twist is applied to the rotor blades. The separate discs are forged in high-temperature stainless ferritic steel and the faces of these discs, together with the blade roots, are cooled by air taken from the compressor outlet and fed down the central shaft.

The Nimonic 75 stator blades are cut from rolled strip section and retained in their austenitic steel shroud segments by welding : the shaped holes are cut in the shrouds by spark machining. The complete turbine stator is composed of eight independent segments, the ends of which are located on unsplit rings on the turbine central and exhaust housings. Gaps between the segments accommodate the circumferential expansion without any radial distortion, sealing strips being fitted between the segments to prevent gas leakage.

Behind the turbine a spider is supported kinematically by flexible strips in a tangential plane at the ends of the radial struts. The struts carry oil to and from, and cooling air into, the rear bearing housing. The far end of the rotor assembly, which is dynamically balanced after being built up and with the compressor baffle and turbine inlet casing supported around it, as it is seen in Fig. 2, drives by means of a toothed coupling a David Brown reduction gear, which makes an interesting comparison with that of the large gas turbine described on page 319. This also is a planetary gear and not truly epicyclic, and there are three planets which afford complete location of the input and output wheels. The reduction provided is large—19,250 r.p.m. to either 1200 or 1500 r.p.m. —and helical teeth are used ; all the gears are MAAG ground. The gearbox bearings are white metal on steel backing. The gearbox drives the fuel pump, lubricating oil pump, governor and tachometer, and accommodates the electric starter motor. The governor is centrifugal, with hydraulic transmission running off the lubricating supply to give protection against collapse of oil pressure ; the single shaft construction facilitates close steady speed-keeping, while speed can be reduced to 33 per cent maximum at zero power. An auxiliary oil pump running off the starter batteries is used at starting and while the engine is cooling down. Safeguards are also provided against overspeed and over-temperature.

If required, the baseplate can carry the driven unit, the use of toothed couplings within the gearbox allowing a certain amount of tolerance on location. As on the Ruston "TA," the lubricating oil is contained within the frame below the engine, as seen in Fig. 5.

The engine runs at a design pressure ratio of 3·5 and a turbine inlet temperature of 800 deg. Cent. (1470 deg. Fah.), giving 430 h.p. in an ambient temperature of 80 deg. Fah. (representative of a ship's engine-room) with an efficiency of 12 per cent. One intended for marine auxiliary use can be seen in action at the Engineering, Marine, Welding and Nuclear Energy Exhibition.

On the stand of B.S.A. Motor Cycles, Ltd., at the same exhibition, there was displayed the smallest of three series of turbo-blowers, the 100/200, 200/400, and 400/600, these figures suggesting the horsepowers of the engines with the supercharger in question installed. The air delivery of each size is indicated in the diagram Fig. 4; a compressor efficiency of 80 per cent is expected at the design point, and turbine inlet temperatures of 750 deg. Cent. intermittently and 650 deg. Cent. continuously are acceptable.

The design of the unit has been discussed at some length* and the construction can be studied in Fig. 1. The intention has been that

* C. A. Judson and E. Kellett, "The Design and Development of Small Radial Flow Turbo-Chargers," I.Mech.E., Symposium on Superchargers and Supercharging, April, 1937.

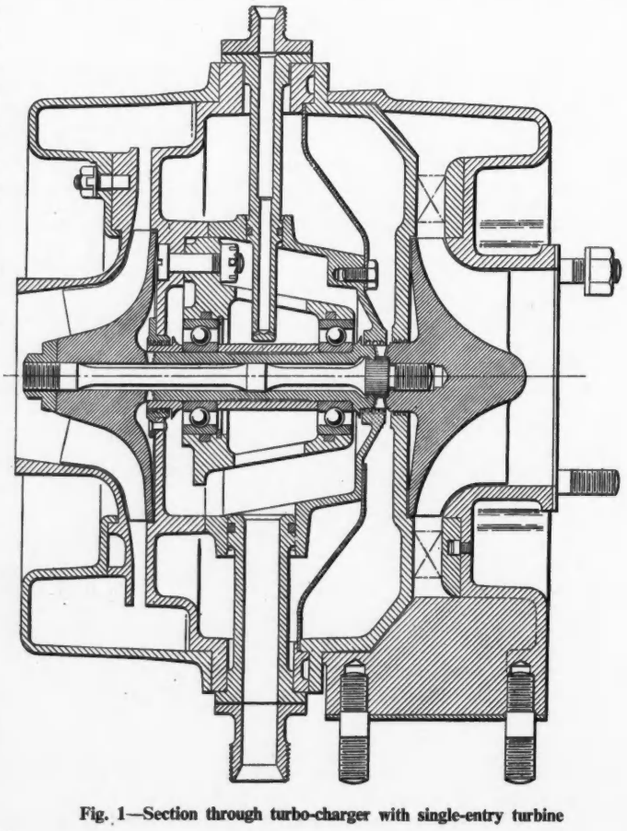


**Fig. 1—Section through turbo-charger with single-entry turbine**

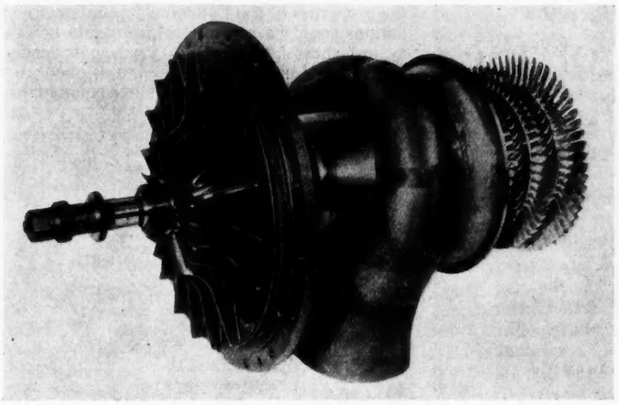


**Fig. 2—The turbine rotating assembly ready for balancing. The teeth on the front of the shaft engage a coupling leading to the gearbox**

manufacture of the machines should be undertaken as largely as possible within the B.S.A. group, and thus there is a widespread use of castings, including sand, lost wax, and pressure die castings, and the turbine wheel is of Jessop G.18 B for machines running at compressor pressure ratios of 1½; for 2 : 1 Nimonic 90 is used. The turbine casing is of a specially developed low-chromium low-silicon iron, cast in sand. A radiation shield separates the turbine

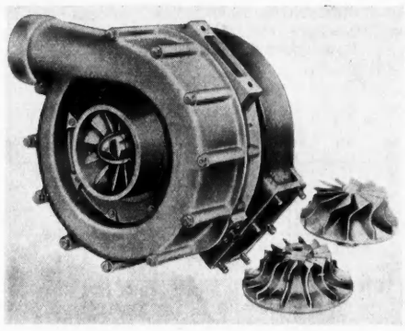


**Fig. 3—Turbo-charger with single-entry turbine ; the rotors are also shown, the turbine having a Hirth coupling**

from the light alloy casings ; no external cooling is required, nor is cooling air bled from the compressor. The rotating assembly is aligned by Hirth couplings and secured by a steel stud screwed into a plug hole in the turbine ; splines on the stud engage others in the shaft to provide locking, and to ensure that the rotor can be assembled with the stud right home the number of splines is not a multiple of the number of serrations on the coupling. To preserve the very high degree of balance needed by running speeds of the order of 60,000 r.p.m., the couplings are marked and must always be assembled in the same attitude. The experience with these units has been that fouling of the turbine never occurs, but that cleaning of the compressor may be necessary as often as every 1000 hours. The bearing life is already established as over 8000 hours, and it is expected that overhaul lives will be made to match those of the engines.

As an alternative to the symmetrical single-entry turbine casing shown in Fig. 4, there is a casing with two tangential intakes. The compressor can be assembled at any attitude with respect to the turbine at 30 deg. intervals; the shaft must be horizontal. Much study has been devoted to the matching of engine and turbo-blower, the method of obtaining the highest output is to match for maximum torque and, at higher engine speeds, by-pass the exhaust turbine to maintain a constant charge pressure — the limitation of turbine speed is in this way avoided. The maximum torque may be prescribed by smoke limit, turbine temperature, or, on enginesnot specially designed, cylinder pressure.

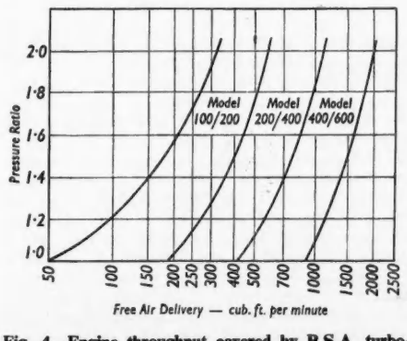



**Fig. 4—Engine throughput covered by B.S.A. turbo-chargers**

An example of a blown engine demonstrated to us was a 9·6-litre Volvo running at a boost of one atmosphere ; at 1500 r.p.m. the best efficiency was obtained at a brake mean effective pressure of 150 lb per square inch and a consumption of 0·352 lb/b.h.p.-hour. At 2000 r.p.m. the efficiency had dropped, but was better at 150 lb per square inch b.m.e.p. than the peak with the engine at this speed and turbo-charged to 1·5 atmospheres. With the gas by-passes closed at all times it was shown that abrupt acceleration produced but slightly black smoke.

This engine has now been developed, by application of an intercooler, to give 180 lb per square inch b.m.e.p. at 1200 r.p.m.; this is obtained with a turbine inlet temperature of 680 deg. Cent.

To confirm the advantages of the pressure-charged engine in operation, trials were carried out with a B.S.A. turbo-charger added to the 4·5in by 5·5in, six-cylinder Daimler " C.D.6 " engine installed in a double-deck bus, with the result that the output became closely similar to that of the alternative 5in bore engine used in adverse territory. The experimental vehicle was taken to a municipality with large-engined buses in service and a series of service trials carried out.

The improvement in fuel consumption was sometimes 2 per cent, and in one case, on a route giving a very low fuel utilisation, 7·2 per cent. An exception was a route along poorly surfaced and narrow twisting lanes, on which fuel efficiencies were 5 or 6½ per cent worse. However, the trials were conducted with an all-speed governor which failed to respond to the final decrement of engine speed as the vehicle was stopped, as shown by the engine stalling on down grades, or gaining speed on up grades when neutral was selected. Tests showed that the fluid coupling might be dissipating the equivalent of 3·25 pints per hour of fuel instead of the normal 1·5 pints per hour when idling, while the fast idling in neutral was costing at least 0·5 pints per hour. Allowance for this shortcoming in an individual fuel pump suggested that even on the least favourable route turbo-charged vehicles would be more economical than larger-engined, normally aspirated examples of the same power. It should be noted that the six-cylinder vehicle was ballasted to the same weight as the original bus, so that additional savings on fuel, tyre wear and driver's effort are to be envisaged. Fig. 6 shows a set of characteristics for the turbo-blown Daimler engine. Peak cylinder pressures have been measured on this engine, both normally aspirated and at its nominal 1 atmosphere boost. Normally aspirated, the peak pressures fall with speed, and the highest figure observed is 920 lb per square inch at 1000 r.p.m. and 100 b.m.e.p. Turbo-charged, the peak pressures at the same torque are 1000 lb per square inch at 1000 r.p.m. and 1150 lb per square inch at 1800 r.p.m.; these figures fall to 870 lb per square inch and 990 lb per square inch if injection is retarded to 21 deg. b.t.d.c. instead of 27 deg.

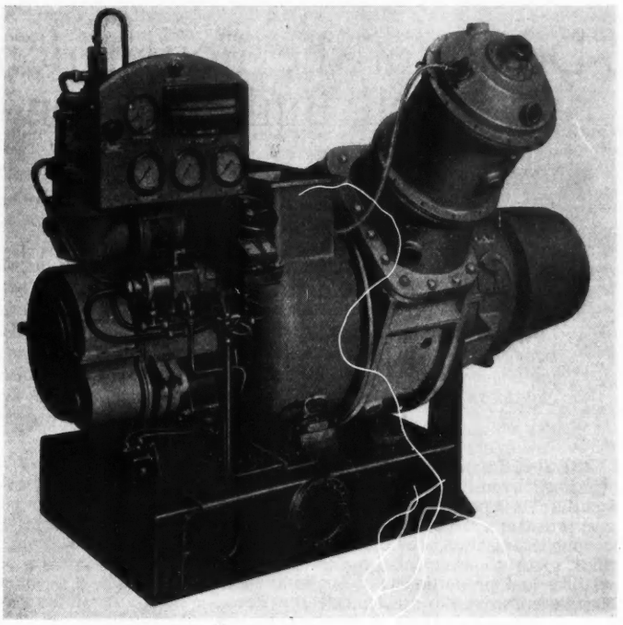


**Fig. 5—The engine is seen fitted with a torch igniter but no sprayer.**

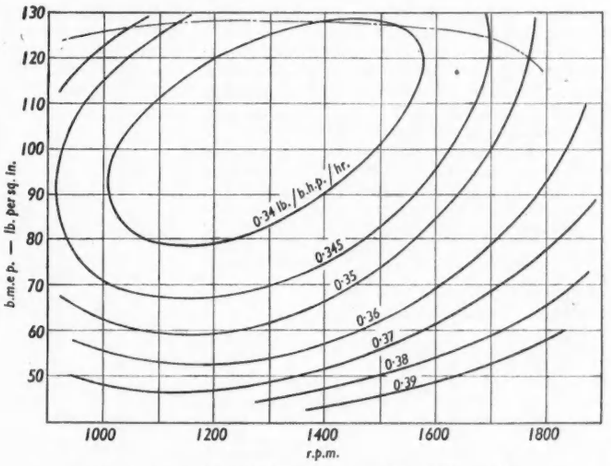



**Fig. 6—Characteristic of turbo-charged 8·6-litre engine**

# Design of the Foundations of the Shell Building, London*

By G. M. J. WILLIAMS†

*The Shell building will impose varying pressures on the ground, ranging from a net increase of 2·2 tons per square foot to a net decrease of 1·8 tons per square foot. The site is underlain by London clay and considerable differential settlements will occur. Several tube railway tunnels pass under the site and the adjacent foundation loads must be taken below them. Some other parts of the building must also have deep foundations to avoid excessive differential settlements: these will consist of concrete cylinders cast in situ with enlarged bases. The remainder of the building will be supported on shallow foundations resting on the London clay. The excavations for the large basements will cause the London clay to swell, resulting in an upward displacement of the railway tunnels. It is estimated that this will be between 0·8 and 1·5in.*

THE Shell Company's building, now under construction on the South Bank, marks a new departure in London building. The designers have provided a large open area at ground level for public amenities, combined with sufficient office space to make the project financially possible, and proportionate car-parking space. They have also had to provide extensive recreational facilities, including restaurants, gymnasia, a swimming pool and a cinema. These requirements have led to a relatively small part of the site being occupied above ground by office blocks, including one block of twenty-seven storeys, and deep basements over the whole site to accommodate the garages and spaces requiring large spans, such as the gymnasia, swimming pool and cinema. These must be placed underground to leave sufficient open space at ground level. The strata under the site are shown in Fig. 1. This land was once part of the riverside marshes and was raised to its present level about 200 years ago. Immediately below the filling there is a stratum of very soft, recently deposited clay of thickness varying up to 20ft, containing occasional layers of peat. This clay, which has a cohesion of about 450 lb per square foot, is locally referred to as "Bungum." Beneath the Bungum there lies a stratum of dense sandy gravel which is saturated with water under a slight artesian head, with a rest-level about 15ft below the ground surface. Standard penetration tests made in this gravel gave results between forty-five and seventy blows per foot penetration.

Beneath the gravel lies the London clay—a stiff, fissured, over-consolidated Eocene clay which is about 100ft thick under this site. A large number of 4in diameter undisturbed samples were taken of the London clay, and the variation with depth of their properties is shown in Fig. 2.

* This paper was presented at the Fourth International Conference on Soil Mechanics and Foundation Engineering. Here we abstract from Volume 1 of the proceedings of the conference, which are published by Butterworths Scientific Publications, 88, Kingsway, London, W.C.2.

† Scott and Wilson, Kirkpatrick and Partners.

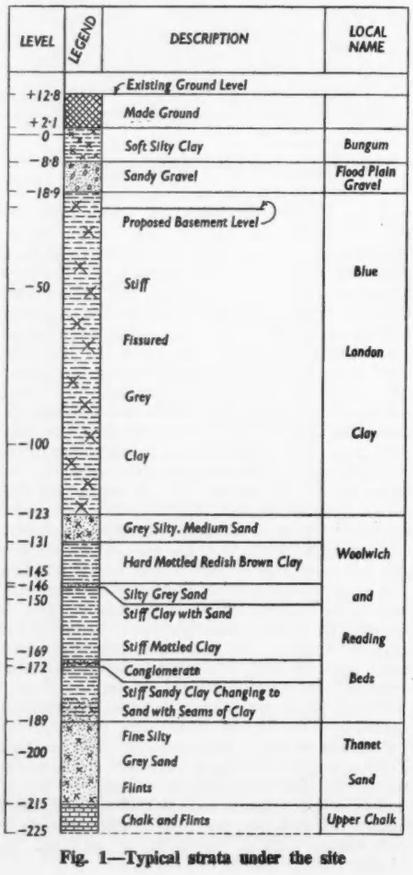



Fig. 1—Typical strata under the site

In a few cases the effective stress parameters, $c'$ and $\phi'$, were determined by measuring pore-water pressures in undrained triaxial tests. They were found to be 300 lb per square foot and 20 deg. respectively. The coefficients of volume change in compression plotted in Fig. 2 are the values for an increase in effective pressure of 1 ton per square foot beyond the pre-consolidation pressure of each specimen. The coefficients of volume change in swelling were determined for a decrease of 1 ton per square foot from the critical pressure, i.e. the pressure required just to stop the sample swelling when water is first put into the consolidation cell. The coefficient of consolidation $c_v$ was found to be independent of depth, with an average value of 4 sq. ft. per year.

Comparing the pressures shown in Fig. 3 with the properties of the London clay, shallow foundations could be provided which would be safe against shear failure. Even the heavily loaded tower would only exert a pressure of about 3·8 tons per square foot on a raft of area equal to that

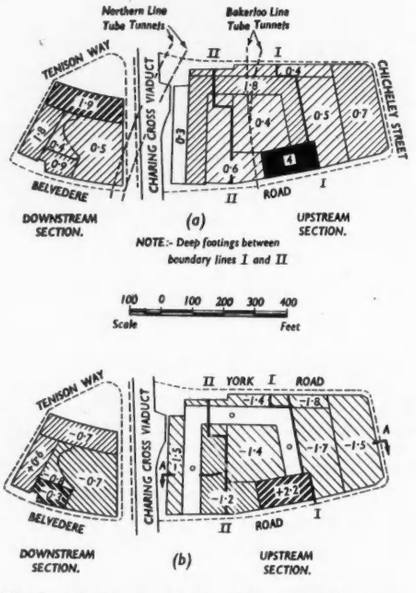



Fig. 3—(*a*) Average total weight per unit area in tons per square foot. (*b*) Average net weight per unit area in tons per square foot.

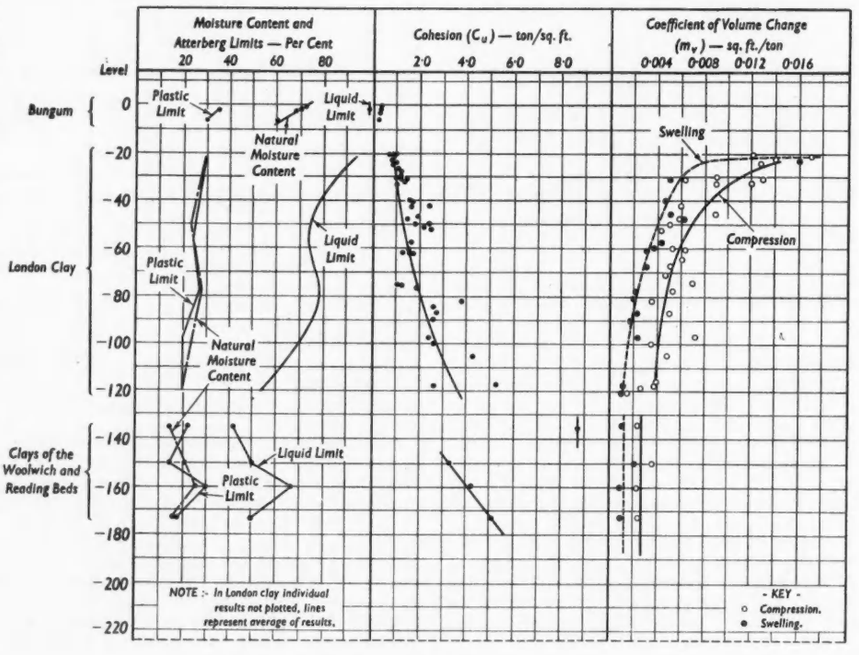



Fig. 2—Soil properties

of its superstructure, and such a raft would have an ultimate bearing capacity of at least 11 tons per square foot. It would settle about 5in in 100 years, after making allowance for the weight of the soil excavated, and a stiffened basement would be necessary to avoid dangerous differential settlements towards the corners. Otherwise this settlement could be accepted provided, first, that there was no danger of the tower tilting, and secondly, that any adjacent parts of the building could be planned to limit differential settlements between them and the tower. In other words a shallow foundation on top of the London clay could be provided for a tower of twenty-seven storeys provided that it was at the centre of a symmetrically loaded area, and that the number of floors and depth of the basements of the sur-

rounding structure were planned to eliminate serious differential settlements. A cross-section of such a building is shown in Fig. 4.

However, in the present case, if they were both founded on top of the London clay, the presence of the Chicheley Street wing on one side of the tower with nothing to counterbalance it on the

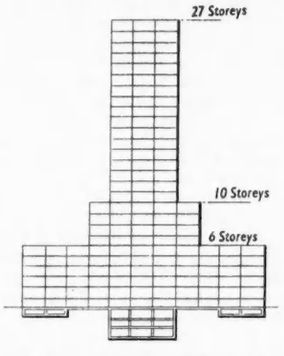



**Fig. 4—Section of building planned to minimise differential settlement**

other side would cause a differential settlement of about 2in to develop across the tower in 50 years. This tilt would be too great to be acceptable. Neither is the second requirement for a raft foundation met because adjacent to the two shorter ends of the tower there are areas with deep basements and no superstructure. The swelling of the London clay due to the reduction of vertical pressure could cause these areas to heave about 3in in 50 years, when there might be a differential movement of up to 7in between them and the tower. For these reasons it was decided to found the tower at a depth sufficient to eliminate the majority of the settlement attributable to the London clay.

### Underground Tunnels

Four tube railway tunnels lie in the London clay beneath the site in the positions indicated in Fig. 3. These tunnels are lined with bolted cast-iron segments, the rails resting on concrete inverts cast inside the lining. There will only be 5ft of soil between the basement floor and the crown of the upper Bakerloo Line tunnel crossing the upstream section of the site. The heaving of the London clay caused by the reduction of the overburden when this basement is excavated will cause these tunnels to rise appreciably. This heave can be divided into the "elastic" heave which will occur immediately, and the slow swelling due to the reduction of the vertical pressure in the underlying clay which will persist for several centuries. The rapidly occurring "elastic" heave would be much more likely to damage the tunnels than the subsequent swelling, because the latter will occur so slowly that the tunnels will be able to adjust themselves to the change in shape by plastic deformations and small movements between the segments.

If a value can be assigned to Young's modulus for the underlying soil, the "elastic" heave can be calculated. Unfortunately, very few measurements have been made of Young's modulus for London clay in unloading; however, a value of 1000 tons per square foot was assumed.

Since the basement excavation is some 500ft wide and the London clay is only about 100ft thick, the various strata beneath the London clay could also contribute to the heave. The Thanet sand and the chalk are not likely to swell perceptibly under the decrease in vertical pressure, and Young's modulus for them has been assumed infinite; but the Woolwich and Reading beds contain clays whose properties as measured in the laboratory did not differ greatly from those of the London clay, and thus a value of 1000 tons per square foot could also be assumed for Young's modulus of these beds, to simplify the calculations. However, the Woolwich and Reading beds contain a number of strata of sand, so that their average Young's modulus is probably greater than this. Furthermore there is evidence obtained, during tunnelling through them, that the Woolwich and Reading clays are much harder than the London clay, and sample disturbance may have caused the laboratory tests to give low values for the various properties of these clays—in one case 200 blows were required to obtain a 4in sample of these clays.

Assuming an average value of 1000 tons per square foot for Young's modulus through the full thickness of both the London clays and the Woolwich and Reading clays, the elastic heave of the tunnels would be 1·5in, whilst it would be 0·8in if Young's modulus of the Woolwich and Reading beds was assumed infinite. The true value probably lies between these values and is most probably nearer to the lower end of the bracket. The same calculations show that the tunnels will deflect the full amount over a distance of about 150ft.

The tunnels are flexible in a longitudinal direction and are unlikely to suffer any serious damage from this heave, which will mostly be taken up by a series of very small movements between adjacent rings. However, it is known that during their construction cases occurred when the bolt holes were badly aligned and the bolts were driven in forcibly. Such bolts might resist the movement between the rings and set up high local stresses which could break portions off the flanges of the segments. To prevent this an examination is to be made of the tunnels before the excavation commences, to locate and remove all force-fitted bolts.

Other works in their vicinity have shown that, whilst the tunnels are flexible longitudinally, they are susceptible to damage from changes in the distribution of the radial pressures acting on them. To avoid this, all loads from the building coming down in the vicinity of the tunnels must be taken down to a depth well below them before being transferred to the soil; and under the York Road wing in particular some large foundation beams will be necessary to carry the building over the tunnels.

### Deep Footings

Thus there are two sections of the building which for differing reasons must be on deep footings, and otherwise, for economy, it is desirable to restrict the areas of deep footings as much as possible. However, in 50 years as much as 1in differential settlement could develop between those twelve-storey sections of the building founded on shallow footings and those on deep footings, whilst the sections without superstructure could rise 2in with respect to the sections on deep footings. Thus the boundaries between the sections on deep and shallow footings must be located where these differential settlements will be least serious, at the same time limiting the number of deep footings as much as possible. The boundaries are shown in Fig. 3.

The deep foundations will consist of solid concrete cylinders cast *in situ* with belled-out bases, a single cylinder of suitable size being placed under each column to avoid the need for pile caps. The London clay is suited to this form of construction because it will stand well for short periods with little support. Calculations showed that if the cylinders were founded at the bottom of the London clay the settlements due to the clays in the Woolwich and Reading beds would be small and could be accepted.

The cylinders, however, could not be founded on the stratum of sand at the top of the Woolwich and Reading beds immediately below the London clay because this sand contains water under a head of about 40ft which would burst into the excavation for the cylinder shaft. The inrush of water would loosen the sand underneath to an unascertainable extent and whilst this could be overcome by filling the shaft with water and excavating the lower parts in the wet, it would not be possible to enlarge the base, the bottom could not be inspected and the concrete lining would have to be placed under water. These difficulties could be overcome by excavating the lower parts of the cylinder shaft under compressed air, but only at greatly increased cost. Thus the best level for founding the cylinders is just sufficiently above the bottom of the London clay to ensure that there is no danger of the bottom being blown up when the base is enlarged.

The ultimate carrying capacity of a single cylinder was taken as the sum of a pressure acting on the enlarged base of nine times the cohesion of the underlying clay and a shear force on the sides of the shaft above the enlargement of 0·7 times the cohesion of the adjacent soil. The factor of 0·7 is taken in over-consolidated clays to allow for the clay softening when wet concrete is placed in contact with it. Each group of cylinders was checked to ensure that the ultimate carrying capacity of the group did not exceed the sum of the ultimate carrying capacities of the cylinders within it. A factor of safety of three was allowed when determining permissible carrying capacities from the ultimate carrying capacities.

The shallow foundations were designed with bearing pressures not exceeding 1·6 tons per square foot for strip foundations, and 2·1 tons per square foot for square foundations.

The avoidance of excessive differential settlements was frequently the deciding factor in designing the shallow footings. The designers have sought to ensure that at the end of 100 years the differential settlement between two adjacent columns will not exceed 1/500 of the distance between them.

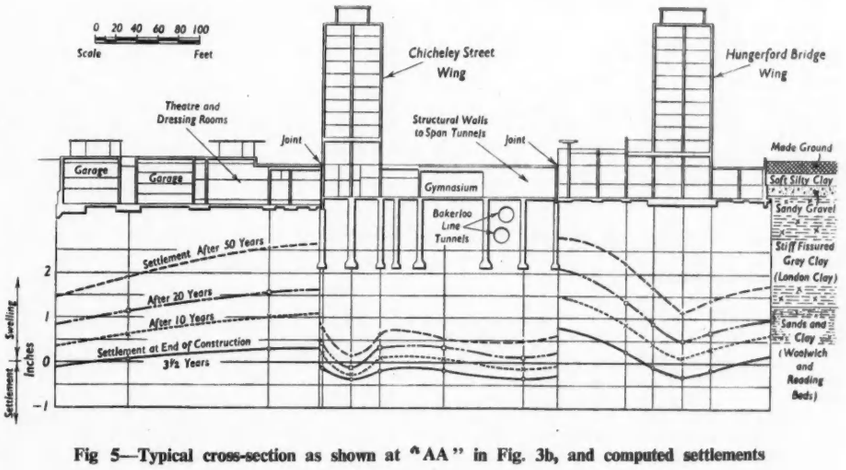



**Fig 5—Typical cross-section as shown at "AA" in Fig. 3b, and computed settlements**

Fig. 5 shows a typical cross-section through the foundations together with the calculated movements along this section at various intervals of time. The compression and swelling of the Woolwich and Reading beds have probably been over-estimated so that the movements shown represent the upper limit of those expected.

The architects for the building are Messrs. Easton and Robertson, and the consulting engineers are Messrs. Scott and Wilson, Kirkpatrick and Partners, both of London. The author is indebted to Professor Skempton for bringing to his attention various observations that have been made of heave due to the expansion of the London clay under an excavation.

# Metallurgical Topics

## Decomposition of Austenite in 12 per cent Manganese Steel

THE behaviour of 12 per cent manganese steel (carbon 1·28 per cent) when heated isothermally within the range 200 deg. to 500 deg. Cent. has been studied by G. Collette[1] in order to follow the stages in the decomposition of the austenite and measure the kinetics of the transformation. The method employed involved the use of the isothermal microcalorimeter described by F. Wever, O. Krisement and H. Schadler for the kinetic measurement of transformation and precipitation processes in alloys. The manganese steel was heated for thirty minutes at 1050 deg. Cent. in an atmosphere of argon to prevent surface decarburisation, and quenched in water. With the steel in this fully austenitic initial condition, it was possible to recognise three separate

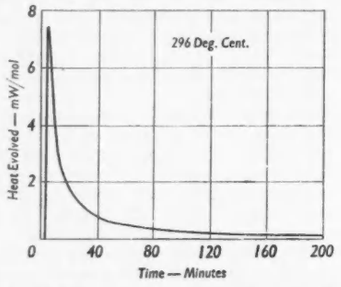



**Fig. 1—Evolution of heat in tempering quenched 12 per cent manganese steel at 296 deg. Cent. (Collette) 1mW=0·014 cal./min.**

processes in the isothermal decomposition of the austenite :

1. At the beginning of the experiment there was an emission of heat, decreasing almost hyperbolically with time, in the course of which a carbide film was deposited in the grain boundaries.

2. This was followed by precipitation of carbide in the form of plates within the austenite grains. The associated heat evolution indicated a process proceeding by way of nucleation and grain growth.

3. Finally, at a sufficiently high temperature, the formation of pearlite may occur, also proceeding by way of nucleation and grain growth.

The first process was most evident at the lower temperatures, for example at 296 deg. Cent. (Fig. 1). As the temperature of the isothermal treatment was raised, the first process was more rapidly succeeded by the second (precipitation of carbide within the austenite grains) as shown in Fig. 2. The maximum heat evolution associated with the second process is greater in amount and occurs earlier as the temperature of the isothermal treatment is raised. It is with this second process that the paper mainly deals. From the temperature dependence of the time at which the curves of heat evolution pass through a maximum value, and from the amount of heat evolved at the time of the maximum value, the activation energy of the carbide precipitation as plates was estimated.

When the quenched specimens were cold worked 20 to 36 per cent before isothermal treatment, the kinetics of the precipitation process were considerably altered. Superimposed on the first process referred to above, and yielding a considerably greater evolution of heat, is the tempering of the martensite which was formed during the cold working of the steel. The paper deals mainly, however, with the effect of cold work on the second process, the precipitation of carbide in plates. This is about sixty times as rapid in the cold worked material as in the quenched steel. Although cold working had a marked effect on the kinetics of precipitation, the difference in amount of deformation between 20 and 36 per cent was without much influence. The activation energies, calculated as in the case of the undeformed specimen, were practically independent of the amount of cold working, though different from that of the quenched material. There were unexplained differences in the relative values, depending on the method of calculation.

It is possible to predict from microcalorimetric measurements the time at which the carbide precipitate within the austenite grains will become visible in the optical microscope. These predicted times were as shown in Table I.

TABLE I—*Time of the Appearance of the First Evident Precipitation in Plates.*

| Temperature deg. Cent. | Quenched steel | | Steel cold worked 36·6 per cent |
|---|---|---|---|
| | Observed | Predicted | Predicted |
| 300 | About 30 hr. | 28 hr. | 34 min. |
| 400 | Between 8 and 15 min. | 22 min | 22 sec. |
| 450 | About 4 min. | 4 min. | 4 sec. |
| 500 | Between 1 and 2 min. | 55 sec. | 0·8 sec. |

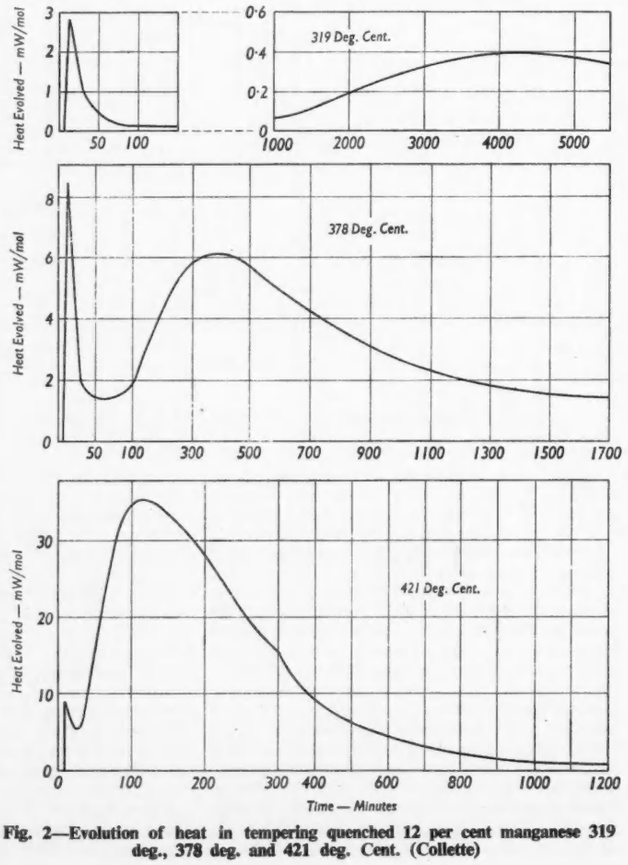



**Fig. 2—Evolution of heat in tempering quenched 12 per cent manganese 319 deg., 378 deg. and 421 deg. Cent. (Collette)**

Though no microscopical measurements were made in the case of the cold-worked steels, a comparison with metallographic observations made on the quenched steel during isothermal treatment confirmed the predictions.

The transformation of austenitic manganese steel has also been the subject of a recent paper by A. E. W. Smith.[2] The temperature range studied by him (about 300 deg. to 850 deg. Cent.) was wider ; but within the range common to both papers there was some measure of agreement as to the form of the carbide and the time of its first evident precipitation at 300 deg. to 500 deg. Cent. The separation of films of carbide in the grain boundaries was, however, observed only at the upper temperatures (e.g. 800 deg. Cent.) and not as a primary stage at the lower temperatures, as described by Collette.

No tests on the cold-worked material are reported by Smith, but his expectation that initial cold straining will increase the rate of transformation of the austenite is confirmed by Collette, though Collette's reference to the tempering of "martensite," as an effect superimposed on the low-temperature transformation or primary emission of heat in the cold-worked steel, may need some verbal amendment.

REFERENCES

[1] *Archiv für das Eisenhüttenwesen*, April 1957, page 229.
[2] *Journal of the Iron and Steel Institute*, August 1957, page 425.

## Titanium Tubing

TITANIUM tubing, made from the commercially pure metal by inert-gas, shielded-arc welding of rolled strip and subsequently cold drawn to size, has been produced since 1950, but the only seamless tubes available were obtained by cold drawing drilled bar. In 1952, shortly after Babcock and Wilcox (Beaver Falls, Pa.) had installed the Ugine-Sejournet process using glass for lubrication, they were asked by one of the titanium producers to extrude and cold work a small quantity of titanium tubing. Progress has been described by T. M. Krebs.*

To produce a homogeneous ingot suitable for the manufacture of tubing it was necessary to employ double melting under vacuum, first using high-purity sponge and then a consumable electrode. Seamless tubing is produced from a round billet, approximately 7in in diameter, which has been forged from a large ingot so as to permit maximum forging reductions with attendant homogenisation and grain refinement. The forged stock is then turned. The scalped billets are heated for piercing in an inert gas atmosphere to prevent absorption of oxygen and nitrogen, both of which are embrittling agents. Slow heating gives better results than the more rapid induction heating. Piercing and extrusion are carried out at 870 deg. to 925 deg. Cent. for commercially pure titanium, but a higher temperature may have to be used for the stiffer alloys. At these temperatures titanium works comparably with austenitic stainless steel at 1150 deg. to 1200 deg. Cent. Glass is used as the lubricant for hot operations. At lower temperatures graphite grease or molybdenum sulphide may be used but care must be taken to avoid contamination of the metal by the lubricant. After extrusion, cleaning and straightening, the tubing corresponds to a hot-finished product. Commercially pure titanium tubing has been obtained as an extruded product with a turned or ground outer surface and, if required, with a bored inner surface, in sizes from 3½in up to 6in O.D. Seamless tubing of less than 3½in O.D. is usually finished by cold working on draw benches or roto-rocking machines. Cold-worked seamless titanium tubing with minimum yield strength of 40,000 lb or 55,000 lb per square inch can regularly be produced in sizes as small as 0·012in O.D. A less ductile variety with 70,000 lb per square inch minimum yield strength is available down to 1in O.D.

The same equipment is used as for austenitic

*Metal Progress*, July 1957, page 82.

stainless steel tubing with certain modifications in procedure necessitated by the metallurgical characteristics of titanium and its alloys. Among the properties of titanium which make modification of the procedure important are its limited capacity for plastic deformation, its relatively high yield strength and yield-tensile ratio, requiring more power in forming and close control of forming forces to avoid exceeding the breaking strength. The lower work-hardening tendency of titanium causes less uniform response to deformation in tension. Titanium resists yielding under rapid loading or high rate of strain, and consequently has to be cold worked as slowly as possible. The low modulus of elasticity ($16 \times 10^6$ lb per square inch) coupled with the relatively high yield strength, is responsible for titanium's greater tendency to spring back on forming.

Tubing of the commercially pure grades may be annealed and the ductility restored between cold-forming operations by heat treatment at about 650 deg. Cent. As a final treatment, this leaves the tubing with a yield strength of slightly over 40,000 lb per square inch (17·9 tons per square inch), an ultimate tensile strength of a little over 60,000 lb per square inch (26·8 tons per square inch) and an elongation of nearly 30 per cent on 2in. Annealing in air is satisfactory except for small-diameter or light-walled tubing, for which vacuum annealing is necessary to prevent excessive atmospheric contamination and loss of ductility.

### Titanium Alloy Tubing

The problems encountered in the cold forming of titanium are intensified in dealing with titanium alloys. The yield strength is more than double that of titanium and the ductility, especially notch ductility, is correspondingly lower. Unlike steels, titanium alloys retain comparatively high strength and hardness after annealing. They cannot, like steels, be readily softened for forming operations ; but warming to 200 deg. to 300 deg. Cent. increases their workability in tube manufacture. Some heavy tubular sections of the alpha-beta 6Al-4V alloy have been produced in the as-extruded and heat-treated condition but the problem of cold working to small tube size is as yet unsolved. The best that can be said of the all-alpha 5Al-2·5Sn alloy is that it may have limited cold workability for tube manufacture.

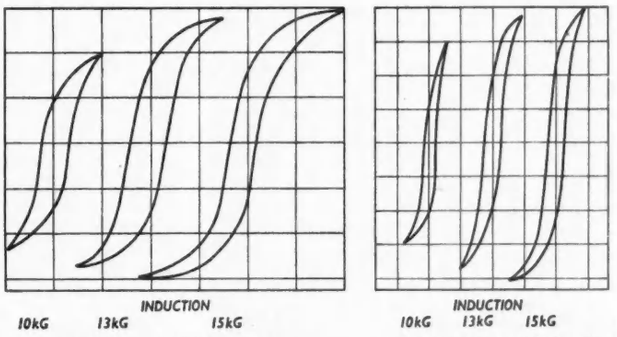
### Utility of Titanium Tubing

The paper concludes with a frank assessment of the possible future uses for titanium tubing. At present about 95 per cent of the titanium mill products are sheet, forgings and extrusions for the aircraft industry. Outside the ordnance and aircraft industries, it is anticipated that the market for titanium alloy tubing for mechanical applications will be slow to develop. Titanium lacks the versatility of austenitic stainless steels, since these may be used either for strength or for corrosion resistance or for both at temperatures considerably above the maximum working temperature of titanium, which is probably about 540 deg. Cent. Titanium is not a high-temperature material in the usual sense, though it is resistant to "high skin temperatures" (up to about 300 deg. Cent.) in aircraft. One advantage that titanium has over austenitic stainless steels is that it is practically immune to pitting corrosion and stress corrosion cracking in most chloride solutions. In the article, an illustrated example is shown of a heat exchanger 16ft long, made with forty-eight tubes 1in by 0·075in, of titanium with a minimum yield strength of 55,000 lb per square inch (24·5 tons per square inch), which gave excellent service in a 15 per cent solution of sodium hypochlorite in a chemical plant, and thus solved a serious corrosion problem. It is anticipated that titanium tubing of this grade, which combines useful strength with good ductility, will be of interest mainly because of its excellent resistance to corrosion. If it becomes apparent that in any particular instance titanium will give two or three times the life of stainless steel, the saving in maintenance may compensate for the extra cost of material and manufacture. As the author of the article rightly says : "In essence the decision to be made is no different from that faced by the engineer who changes from carbon steel to a considerably more expensive stainless to solve a corrosion problem."

## Hot Pressure Bonding of Metals

The hot-cladding, or bonding a metal with special surface characteristics to a cheaper metal or alloy, or to one with superior mechanical strength, has been a long-established practice with certain materials. Examples are duralumin coated with pure aluminium (Alclad) and cupro-nickel-coated steel. This method of coating metals is brought about by hot rolling a composite sandwich of the metals in question, with clean surfaces in contact and provision against oxidation during the time that the diffusion bond is being formed. Difficulties may arise if the metals to be bonded form brittle intermetallic compounds in the zone of diffusion. This difficulty has been investigated by S. Storchheim* who, in experiments on the bimetallic systems of aluminium with nickel, copper, iron and zirconium, has shown that the bonding pressure is a critical factor. To judge the quality of the bond, test specimens were made, in a vacuum, under pressure of a ram working within a high-temperature die into which had been charged a slug of aluminium, a disc of the metal to be tested, and another slug of aluminium, the surfaces in contact having been freshly abraded. A tensile test piece was then prepared by screw threading the aluminium ends, the bonded metal being in the reduced section of the acting length. Microscopical examination and measurements of the thickness of the zone of diffusion were also made. Die temperatures from 400 deg. to 600 deg. Cent. were employed, and pressures of from 4000 lb to 40,000 lb per square inch (approximately 1·8 to 18 tons per square inch). Being formed in a die the specimens are produced under hydrostatic pressure and may give more favourable results than would be obtained by rolling if the intermetallic zone contains a brittle constituent in which the rolling stresses may induce micro-cracking. The results reported most fully relate to the aluminium-nickel system. With increasing temperature the bond strength increased rapidly, reached a maximum and then decreased, owing possibly either to the increased thickness of the diffusion zone or to the formation of a brittle intermetallic alloy. For pressures between 10 and 18 tons per square inch the maximum occurred at 500 deg. Cent. With increasing time the bond strength rose to a maximum and then decreased. For a pressure of 10 tons per square inch, this maximum was reached in four minutes at temperatures between 500 deg. and 600 deg. Cent. The strength of the aluminium-nickel bond rose quite rapidly with increase in bonding pressure : it increased from 2·5 to 9 tons per square inch when the pressure was raised from 10 to 18 tons per square inch, the temperature being 500 deg. Cent. and the time four minutes. A similar increase in bond strength with increase in bonding pressures applied to all four systems studied provided the right temperatures and times were used, but in some instances the strength levelled off or actually decreased after the maximum effect of increased pressure had been obtained. The thickness of the diffusion zone increased with rise in temperature, but in the aluminium-nickel bimetallic system, for a given time and temperature, it was reduced by increased pressure. The aluminium-copper system behaved in a similar way. The aluminium-iron diffusion zone also increased with rise in temperature, but in this case an increase in pressure caused a further increase in the thickness of the intermetallic zone. The author suggests that an increase in pressure restrains the growth in thickness of the diffusion zone in systems in which the intermetallics decrease in volume during formation, and that an increase in zone thickness appears to occur when the intermetallics expand during formation. Evidence for this is not given, but the importance of further investigation of the effect of pressure during solid state bonding is emphasised.

* *Metal Progress*, July 1957, page 97.




Annealed 10 hours at 1200 deg. Cent. in pure hydrogen.

Annealed 10 hours at 1200 deg. Cent. in a high vacuum.

**Figs. 1 and 2—Influence of annealing atmosphere on the form of the hysteresis loop of cold-rolled (2·0/1·0/0·35mm) and annealed transformer steel sheet (silicon 4·3, aluminium 0·25 per cent) with inductions of 10kG, 13kG and 15kG. (Reproduced from photographic records)**

## Transformer Steel

Magnetic, metallographic and X-ray diffraction studies carried out by F. Lihl* on hot and cold-rolled transformer steel sheet containing silicon 4·3 and aluminium 0·25 per cent, have confirmed the suggestion that demagnetisation losses are appreciably lower after final annealing of the steel in a high vacuum than after annealing it in a protective atmosphere such as a nitrogen-hydrogen mixture or pure hydrogen. It was shown that in hot-rolled sheet, annealed in a high vacuum, the initial purity of the steel had not so decided an influence as when a protective atmosphere was used, and the deleterious effects of over-annealing on the form of the non-metallic inclusions was less evident. In cold-rolled sheet, grain growth and the formation of a recrystallisation texture favourable to the magnetic properties were helped by annealing in a high vacuum.

The demagnetisation losses, which in high-vacuum annealed, hot-rolled sheet were about 0·84, 1·47 and 2·15 W/kg for inductions of 10kG, 13kG and 15kG, were about 10 per cent lower than the best values obtained after annealing in protective gas. In cold-rolled sheet annealed in a high vacuum, values of about 0·75, 1·35 and 1·9 W/kg were obtained with the same inductions. These losses were about 15 per cent lower than those of the hot-rolled sheet, and substantially lower than those o similar cold-rolled sheet annealed in hydrogen. This is shown in Table I, and also in Figs. 1 and 2, reproduced from the photographic records in the paper.

Economically considered, annealing of transformer steel sheet in a high vacuum should lead to a fall in the cost of production, especially as annealing in pure hydrogen, quite apart from the explosion risk, is very expensive, and the control of high vacuum in the present state of vacuum technique presents no special difficulty in operation.

Table I—*Influence of the Amount of Cold Work and the Conditions of Annealing on the Demagnitisation Losses of Cold-worked Transformer Steel Sheet Containing Silicon* 4·3, *Aluminium* 0·25 *per cent. Annealing Temperature* 1200 *Deg. Cent. ; Time Ten Hours.*

| Stages of rolling† | Conditions of annealing | Demagnetisation loss in W/kg for an induction of | | |
|---|---|---|---|---|
| Millimetres thick | ... ... ... | 10kG | 13kG | 15kG |
| 0·5/0·35 ... ... | Vacuum ... | 0·75 | 1·37 | 2·0 |
| | Hydrogen | 1·05 | 1·81 | 2·4 |
| 1·0/0·7/0·35 ... ... | Vacuun. ... | 0·78 | 1·35 | 2·0 |
| | Hydrogen | 1·28 | 2·09 | 3·0 |
| 2·0/1·0/0·35 ... ... | Vacuum ... | 0·68 | 1·20 | 1·8 |
| | Hydrogen | 1·27 | 2·03 | 2·9 |
| 2·7/0·9/0·35 ... ... | Vacuum ... | 0·73 | 1·36 | 1·9 |
| | Hydrogen | 1·29 | 2·18 | 3·1 |

* *Archiv für das Eisenhüttenwesen*, April, 1957, page 223.

† Between the stages indicated the steel was annealed for three hours at 800 deg. Cent. in a protective gas containing nitrogen 85 per cent, hydrogen 15 per cent.

# LETTERS AND LITERATURE

## Letters to the Editor

*( We do not hold ourselves responsible for the opinions of our correspondents )*

### STANDARDS FOR THE BRITISH AUTOMOBILE INDUSTRY

SIR,—I thank you for the cutting of the review of the above-mentioned handbook which appeared in your issue of August 9. The reviewer has obviously studied the book in great detail and it is gratifying that he finds so much in it to praise. With regard to some of the criticisms, which are generally constructive and therefore welcome, I would like to make the following observations.

First, it should be realised by all concerned that this handbook is intended as a beginning and, with the co-operation of all concerned, it is hoped continually to extend and improve it. With regard to tyres and wheels, your reviewer seems to be unaware that for many years the S.M.M.T. has published tyre and wheel standards and, incidentally, these have been printed by the printers of THE ENGINEER. At the moment, the latest editions of these tyre and wheel standards are being printed and, when ready for issue, in addition to the separate book of tyre and wheel standards, they will form the tyre and wheel section of the handbook.

With reference to committee membership, this is generally confined to members of the S.M.M.T., but all committees have powers to co-opt and there is very full consultation with outside interests before any S.M.M.T. standard is published. With regard to components, it should be appreciated that a standard is not necessarily a complete specification, but may establish only some basic information (such as envelope dimensions) of use to the designer. Standards should not restrict development or competition, but if designers can be persuaded to work with a range of agreed standards instead of calling for "specials," then considerable benefits can be obtained by the suppliers of materials and components, the vehicle manufacturers, the general public and the national economy.

E. WOODBRIDGE

Standards and Technical Manager
Society of Motor Manufacturers and Traders
London, W.1,
August 12, 1957.

### FAIRGROUND TUNNEL RAILWAYS

SIR,—In 1895, when I was four years old, my parents took me one afternoon to Hull Fair, where I saw one of these tunnel railways working. There were three trains running simultaneously, — a "slow," a "semi-express" and an "express." The three trains ran on parallel circular tracks and the engines and coaches were exactly as shown on Fig. 2 of Mr. Abbott's article in the August 9 issue of THE ENGINEER. It would appear, therefore, as though these engines and trains were manufactured for a home and not a Continental client.

I persuaded my father to take me for a ride on one of the trains. As the fares were graded according to whether you travelled per slow, semi-express or express, the slow train being the cheapest my father, being a Scot, took me on the slow train. However, I had the satisfaction as we progressed through the tunnel, of seeing "the express" flash past our train, moving in same direction, three times.

NORMAN DUNCAN

York,
August 12, 1957.

## Book Reviews

**Principles of Engineering Inspection.** By GEOFFREY K. KING and C. T. BUTLER. Cleaver-Hume Press, Ltd., 31, Wrights Lane, Kensington, London, W.8. Price 25s.

THE authors in their preface say that they hope that this book will commend itself to technical students working for the City and Guilds examination in the subject and for Associate Membership of the Institutions of Mechanical and Production Engineers, university students and managers and inspectors in industry. As a basis for it they have taken what they consider the best de-limitation of the subject, the new syllabus 70 for the City and Guilds of London Institute, Sections 1–10 and 27–28.

The book contains fifteen chapters, and most of them fall into three main groups, namely: the inspection and testing of primary raw materials; the inspection of machined or processed raw materials and sub-assemblies and the quality and finish of the final product; and the manufacture and inspection of the jigs, gauges, tools and measuring instruments used throughout the inspection system.

The first of these groups deals with the inspection and testing of most of the metallic and non-metallic raw materials, metallurgical examination, inspection of primary production (such as castings and forgings) and its ancillary test equipment, including radiography and non-destructive testing, heat-treatment and anti-corrosion coatings. The second section covers the interpretation of drawings, the inspection of machined components, sub-assemblies and final products and the inspection of surface finish: whilst the last group contains chapters on the design and manufacture of jigs and fixtures, the critical examination of machined components and the inspection and functioning of the equipment used for such metrological examinations and for the general inspection processes. In addition there are chapters on the organisation of inspection, the setting up of an inspection system, the statistical control of quality and one on what the authors term the "time element," that is multi-dimensional inspection by mechanical and electronic methods necessitated by modern mass production.

Although an attempt has been made to cover the very wide field embraced by modern inspection, a volume of less than 300 pages cannot hope to deal adequately with every aspect of the subject, and the serious student will undoubtedly have to consult more detailed textbooks on much of the subject matter. The authors have tended to expand on particular facets to the detriment of others, many of which should have had equal attention. In the chapter dealing with the inspection of raw metallic materials, for example, the older kinds of mechanical testing, tensile, hardness, &c., have been fairly comprehensively dealt with, whilst the newer tests, such as creep, are only briefly covered; metallurgical examination, too, merits a whole chapter, although radiological examination is given only a paragraph and the sampling methods for chemical analysis are not mentioned at all.

The scope and a short historical survey of the British Standards Institute is given under the chapter on the interpretation of drawings. In view of the very real importance of British Standard Specifications to the inspector of to-day and of the number of references to these publications made throughout this book, the above information might have been better given in the first chapter, perhaps in more detail. Mention has also been made in a few instances of the Inspection Instructions of the Aeronautical Inspection Directorate, but the authors have not pointed out that these leaflets are written for the guidance of inspectors in the aircraft industry and are not generally available. A curious omission in the chapter on the time element is the lack of information on pneumatic gauging. At least a brief mention of this method, which can cover both individual and multi-dimensional gauging, might well have been given.

It is obvious that the authors have put into this book a great deal of hard work and it should prove a useful reference for administrators, production engineers and inspectors alike. The printing, illustration and presentation are of a high standard.

**Practical R.F. Heating for the Wood Industry.** By J. POUND, M.I.R.E., A.I.E.E. Heywood and Co., Ltd., 9, Kingsway, London, W.C.2. Price 30s.

THE use of radio-frequency heating has been steadily increasing in the furniture and other branches of the woodworking industry for some time, and in this book the author has dealt with the subject from the angle of the woodworker rather than that of the electrical engineer. He has aimed at using the simplest and most readily understood electrical terms available in order that the technical matter should be understood by a reader who is not primarily an electrical engineer.

Synthetic resin adhesives commonly used with radio-frequency heating are first dealt with to give some understanding of the mechanism of their setting which, the author points out, is necessary to appreciate the reasons for using r.f. heating. In thus describing the general principles of r.f. heating the book deals with the basic theory, giving notes on the types of heating by r.f., choice of frequency, timing calculation, and assembly size limitations. This is followed by a complementary chapter on generators, before sections which deal in detail with the design and construction of jigs for assembly parts by r.f. heating, and the three types of heating generally practised —through or transverse, glue line or longitudinal, and stray field heating—with typical examples of equipment. The concluding chapters of the book deal with other electrical heating methods and the economics of r.f. heating. Throughout the book the subject matter is amplified by clear drawings and photographs, and there is a useful glossary of terms at the end.

**The Development of the Trolley Bus.** By HAROLD BREARLEY. The Oakwood Press, Bucklands, Tandridge Lane, Lingfield, Surrey. Price 5s.

THE author does not pretend to present a complete history of the trolleybus, any more than one would expect to find this contained in a few pages. However, development from the father of all trolleybuses, to the vehicles of to-day, is sketched out and a remarkable amount of interesting facts is put on record. There is given a historic outline of the trolleybus in the countries that saw its birth, before a more elaborate system-by-system study of the United Kingdom. From there, the growth of railless traction is traced, the towns in which systems have been extensively employed being dealt with in some detail.

The reasons for the limited and decreasing use of trolley vehicles become evident as the account is studied. The high cost and difficulty of improving or modernising the capital equipment and the inflexibility of the vehicles are obvious ; in many cases Mr. Brearley is able to assign individual vehicles to particular routes. Failure to overcome engineering difficulties is also to be seen ; control systems have commonly given a primitive step-by-step response, and makers have been quite shameless in asking the driver to do the work. The descriptions of individual designs are, however, hardly adequate for an analysis of their merits. One weakness of the book is the absence of references in the text to the many illustrations.

## Books Received

*Glass*. By G. O. Jones. Methuen and Co., Ltd., 36, Essex Street, London, W.C.2. Price 8s 6d.

*The Spectroscopy of Flames*. By A. G. Gaydon. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 50s.

*Scientific German*. By George E. Condoyannis. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 20s.

*Scientific French*. By William N. Locke. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 18s.

*The Solidification of Castings*. Second Edition. By R. W. Ruddle. The Institute of Metals, 17, Belgrave Square, London, S.W.1. Price 42s.

*Nuclear Engineering*. By Charles F. Bonilla. McGraw-Hill Book Company, McGraw-Hill House, 95, Farringdon Street, London, E.C.4. Price 94s.

*Applied Mechanics*. By R. C. Stephens and J. J. Ward. Cleaver-Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W.8. Price 12s. 6d.

*Thermodynamics*. Third edition. By Virgil Moring Faires. The Macmillan Company, 10, South Audley Street, London, W.1. Price 52s. 6d.

*Air Conditioning*. By Willis R. Woolrich, and Willis R. Woolrich, Jr. The Ronald Press Company, 15, East 26th Street, New York 10, New York. Price $7.50.

*Guide to the Coalfields* 1957. By R. H. Walkerdine, and E. G. Corbin. The Colliery Guardian Company, Ltd., 30 and 31, Furnival Street, Holborn, London, E.C.4. Price 20s.

*Perspective Drawing for Technical Illustrators and Draughtsmen*. By P. Manktelow. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 30s.

*Chambers Trades Register of Birmingham and District*. 1957 edition. Chambers Trades Registers and Directories, Ltd., 299–301, Gray's Inn Road, London, W.C.1. Price 42s.

*Basic Mathematics for Radio and Electronics*. Third edition. By F. M. Colebrook and J. W. Head. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 17s. 6d.

*Tables of Integrals and Other Mathematical Data*. Third edition. By Herbert Bristol Dwight. The Macmillan Company, 10, South Audley Street, London, W.1. Price 21s.

# Obituary

## SIR CYRIL KIRKPATRICK

SIR CYRIL KIRKPATRICK, a past president of the Institution of Civil Engineers, died at his home at Chalfont St. Giles on August 25. He was eighty-four.

Cyril Reginald Sutton Kirkpatrick was born on October 17, 1872, and was educated at Repton and the Crystal Palace School of Engineering. He then became a pupil and later assistant engineer of Mr. E. B. Thornhill, the chief engineer of the London and North Western Railway. Further valuable experience was gained by spending ten years with various firms as contractors' engineer, largely on railway work. In 1906 he was appointed city engineer of Newcastle, where he carried out quay improvement works.

He was joint author with Mr. F. W. Davis of a paper describing the constructional work on the King Edward VII bridge, a high-level bridge composed of steel trusses carrying the North Eastern main line across the Tyne at Newcastle. It was designed by Dr. Harrison, the railway company's engineer, and built by the Cleveland Bridge and Engineering Company. The paper was noteworthy for the discussion on compressed air working.

Sir Cyril's career with the Port of London Authority commenced in 1910, when he became chief assistant to Sir Frederick Palmer, the chief engineer of the newly constituted Authority. Expansion to meet the requirements of the port for the next twenty years or more was envisaged at that time. Enlargement of Albert Dock, and the provision of a new entrance lock and a passenger landing stage at Tilbury were amongst the works planned. Palmer resigned in 1912, and Kirkpatrick became his successor. The most conspicuous work completed during his term of office, which ended with his resignation in 1924, was the King George V Dock at North Woolwich, which was opened in 1921. He received a knighthood in 1922.

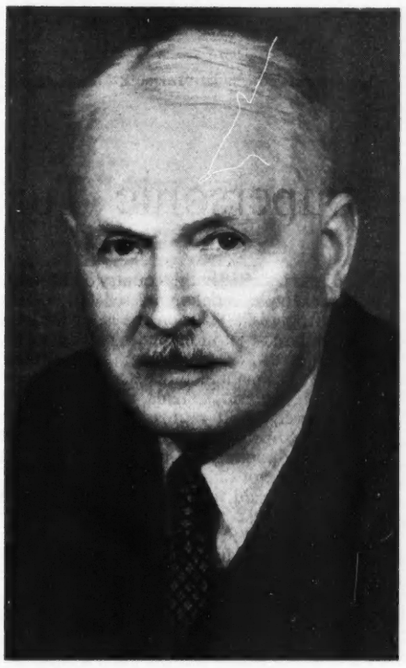
It was at this time that he started to practise as a consulting civil engineer. His firm specialised chiefly in heavy foundations, dock and harbour and sea defence works. Among the undertakings for which he was responsible were the foundations for the power house of the Ford works at Dagenham, foundations and the circulating water system for Tir John North Power Station, Swansea, and foundations for gasworks plant at Stoke-on-Trent, Weston-Super-Mare and East Greenwich ; at the latter works he was also responsible for an underground pumping station together with intake and discharge works in the Thames.

He carried out dock and harbour works at Galway, Maryport and Bangor, Co. Down, and prepared extensive schemes for the improvement and development of the port of Alexandria for the Government of Egypt.

Sir Cyril initiated the design of the civil engineering works for Dekhelia Power Station, Cyprus, the construction of which was completed after his retirement. He was also responsible for the design of power stations in the Sudan.

Perhaps the most important work with which Sir Cyril was associated after leaving the Port of London Authority was in 1943 and 1944, when, as a member of the K.C.D. Group in partnership with Mr. J. D. C. Couper and Mr. Jack Duvivier, he was responsible to the Ministry of Supply for the construction of thirty-three concrete "Phœnix" caissons for the Mulberry Harbour. Most of them were constructed in East India Import Dock and the South Dock of Surrey Commercial Docks, which were dewatered during the period of construction and flooded when the caissons were substantially complete and could be finished afloat, but a number were partially constructed in basins excavated in the banks of the Thames at Barking and Belvedere, which were then flooded and the caissons towed upstream for completion in the docks.

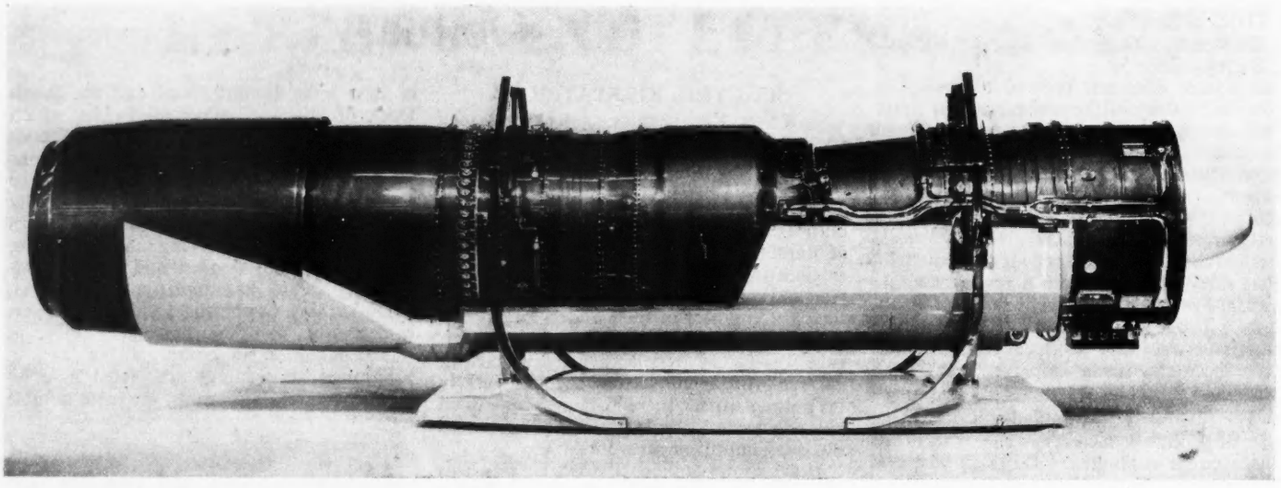
During his career Sir Cyril gave expert evidence on many Parliamentary Bills, at public inquiries, in courts of law and in arbitration proceedings and acted as arbitrator on several occasions, the most notable



**Sir Cyril Kirkpatrick**

being the Rosyth Dockyard arbitration. He retired in 1951 and the firm which he founded was incorporated in Scott and Wilson, Kirkpatrick and Partners. He was a colonel in the Engineer and Railway Staff Corps, R.E. (T.F.), and a member of the Société Ingénieurs Civils de France. In 1935–36 he was chairman of the Association of Consulting Engineers. He was also a member of the Smeatonian Society of Civil Engineers. He was from 1926 a representative of the Government for the Permanent International Association of Navigation Congresses and was appointed a member of the Central Rhine Commission by the Government in 1934. He was also for many years a representative of the Foreign Office at the International Technical Consultative Commission of the Suez Canal Company in Paris.

Sir Cyril's presidential address, delivered at the Institution in November, 1931, dwelt on the history of navigation on the Thames and of the various dock and harbour works built on the river. He went on to outline the contemporary problem of development of the port, as he saw it at the time. His interest in civil engineering history was also apparent from his Vernon Harcourt Lecture, given in 1926, which gave a most fascinating account of the historical development of ports and harbours, ending with notes on the world's principal ports.



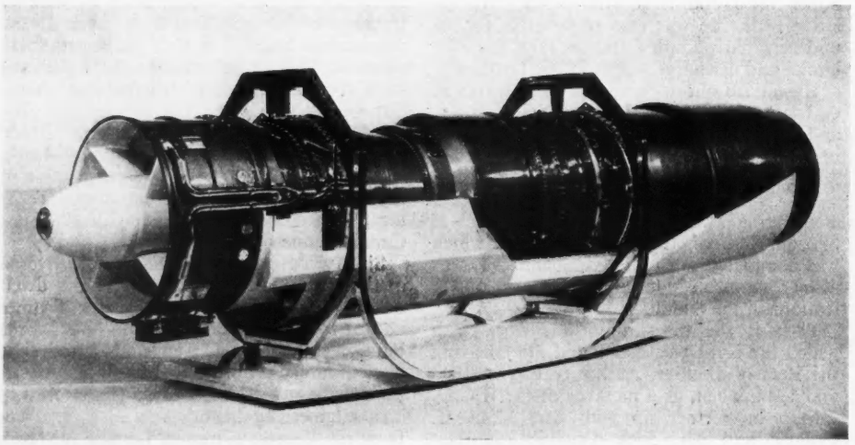
**The supersonic turbo-jet "Iroquois," complete with integral after-burner. Electric control is adopted, the computer being slung under the intake, and the turbine exit temperature sensors located just ahead of the rear support ring**

# Supersonic Turbo-jet "Iroquois"

THERE was unveiled in this country on Monday last an example, serial numbered 001, of the Orenda "Iroquois." This engine is, as far as is known, the largest jet in existence, with a thrust of over 20,000 lb ; 28,000 lb is attributed to it, with reheat. The manufacturers, Orenda Engines, Ltd., Malton, Ontario, Canada, claim that it has the best power/weight ratio of all gas turbines suitable for supersonic aircraft, in excess of 5 lb thrust per pound weight : this is attributed largely to the use of titanium in the construction. The engine was said to be about to take to the air in its flying test bed, a Boeing "Stratojet" to which the seventh engine has been added in a nacelle on the starboard side of the after fuselage.

Little more has been announced, apart from the fact that it was developed as a private venture and is destined for the Avro C.F.105 "Arrow," the Mark II version being named. The display engine is illustrated on this page : it is complete with integral afterburner but has, apparently, a fixed nozzle. The intake extends back to the first circumferential ring of bolts ; it will be noticed that the centre body struts are offset, presumably to allow for large dimensional changes with temperature. Each of the struts has a supply of hot air for de-icing ducted from behind the h.p. compressor. Below the intake the electrical control system is housed in a box isolated on springs damped with felt, and to the right of it there is, apparently, an ignition generator feeding three igniters. The casings of the two compressors are complete rings, with the forward engine support points between them, and a protuberant band near the front of the l.p. casing may denote variable stagger inlet guide vanes. Above the intermediate casing there is provision for either a bleed or blow-off of the l.p. compressor delivery. Below the l.p. compressor there can be seen a power take-off, probably for an alternator drive, facing to the right : the remainder of the ancillaries are enclosed within a shallow metal trough closed on inner and outer sides, being, in the main, separated from the engine proper by a space for cooling air. The combustion chamber is presumably annular, and none of the fuel lines appear on the outer casings : the combustion chamber appears to be remarkably short. The construction of the turbine section suggests that the h.p. turbine is overhung, while the l.p. shaft has a bearing downstream of the turbine, the coolest point after the combustion chamber, where the rear engine support points are. Also at this (comparatively) cool stage are inserted eight thermo-couples which, clearly, drive the fuel control system : the sheaths of the conductors can be seen immediately ahead of the rear support. Close behind this are the numerous sprayers of the afterburner, and further back an annular intake completely surrounding the tail pipe which, presumably, induces air to protect the material of the nozzle. The fire walls enclosing the ancillaries taper away to a very shallow depth at this stage, suggesting that a part of their purpose is to maintain a smooth and fast flow of air over the outside of the power unit.

The use of a two-spool design is not invariable on engines which expect a high degree of kinetic compression, and the principal benefit is likely to be an improved performance away from the design condition, i.e. in subsonic flight. If this is in fact the case, it is surprising that a variable geometry nozzle is not also used. However, it may be that an advanced pattern, possibly an aerodynamic nozzle, is projected and not at this stage fitted.



**The trough enclosing the mechanically driven ancillaries of the "Iroquois" can be seen; at least at the edges, it is separated from the engine casings. The polished pipes leading to the nose cone support struts conduct high pressure bleed air**

## Nitrogen Atmosphere Generator

FOR the production of cheap, clean nitrogen-hydrogen atmospheres for heat-treatment or chemical process work, the Baker Platinum Division of Engelhard Industries, Ltd., have produced an improved model of their "Nitroneal" generator.

The new model, known as the "GNL" "Nitroneal" generator, is made in two sizes to produce 500 and 1500 cubic feet per hour of gas, and, unlike the earlier model, which required an ammonia vapour supply, has a built-in vaporiser and is fed with liquid ammonia direct from cylinders. The refrigerant properties of the ammonia are used to cool the gas down to a dewpoint of 40 deg. Fah.

The gas is produced by cracking the ammonia over a precious metal catalyst into nitrogen and hydrogen, and the same catalyst is used to burn the bulk of the hydrogen with atmospheric oxygen to produce a gas containing from 0·5 to 25 per cent hydrogen. The principal advantages obtained by using the special catalyst in this way are that the reaction is exothermic and no external heat source is required, and that by utilising nitrogen from the atmosphere as well as from the ammonia the gas is produced very economically.

In the "GNL" model, a second stage catalyst chamber is used when the hydrogen concentration required is less than 15 per cent, and this further change in design considerably prolongs the life of the catalyst. It also ensures that the oxygen content of the gas is less than 1 part per 1,000,000.

The hydrogen content of the gas is controlled automatically within 0·25 per cent of the desired concentration, and the generator only requires the attention of an operator for starting, which takes about twenty minutes. There are no pumps or other moving parts, and therefore servicing and maintenance are reduced to a minimum.

# ENGINEERING AND MARINE EXHIBITION

**THE Engineering, Marine, Welding and Nuclear Energy Exhibition which opened yesterday at Olympia, London, once again provides a comprehensive picture of the primary equipment made by some five hundred of the leading manufacturers in this country. Now that so many specialised exhibitions are held it might be thought that this biennial event would tend to decline in importance and interest, but there is no indication of this happening—probably because it covers, in addition to primary plant, that wide variety of ancillary equipment which forms the essential basis for all industrial and marine installations. Preliminary information received from exhibitors indicates that some interesting new developments are to be shown for the first time, and that a large proportion of the conventional equipment incorporates improvements in design. Although in many instances these improvements are in detail and only discernible to the specialist they are nevertheless of importance in providing a means of increasing industrial efficiency. They further show that, despite the full order books which most firms have, the importance of development in maintaining a healthy and progressive industry to meet overseas competition has not been overlooked by British manufacturers.**

**The considerable interest in nuclear energy projects in this country has prompted the organisers of the exhibition to extend its title, and the stands of exhibitors concerned with the development of nuclear energy installations and the supply of the necessary equipment are marked by a special plaque. Visitors will note with interest the fact that, despite their impressive nature, nuclear power installations use a very high percentage of engineering equipment of orthodox design. This equipment is generally different only in its materials and in processing to provide the high degree of reliability and precision to comply with the essential safety requirements of nuclear processes. Probably some of the more outstanding work in this connection has been in the development of special materials and fabrication techniques for major components. Some interesting examples of this work are to be seen on several stands and are well worth inspection. The way in which British manufacturers have been in the fore-front of nuclear power development is universally recognised, and a number of the excellent models to be seen at Olympia give a good impression of the interesting nuclear plants now under construction or proposed for this country.**

**The amount of space available for any comprehensive exhibition such as this and the restrictions imposed by the weight and size of many of their principal products has undoubtedly given a number of firms cause for much thought in selecting a representative range of plant for their stands. This difficulty has been overcome in many instances by the use of models, photographs, diagrams and films, which are in some cases supplemented by the presentation of interesting component parts of major equipment. No better opportunity is presented in this country for inspecting and comparing the products of the principal manufacturers of oil engines, marine equipment, turbines and heavy electrical plant, together with a comprehensive selection of land and marine ancillary equipment including pumps, compressors, control gear of all kinds, hydraulic equipment, gearing, drives, etc. Supplementing these exhibits are representative displays of the products of the firms concerned with the production of materials for all branches of the engineering industry, together with the welding and other equipment and tools required for fabricating purposes by manufacturers.**

**For our articles on the exhibition we have, of necessity, had to select but a small percentage of the many hundreds of exhibits for description, but they will in some measure give a general impression of the progress and trend of development in this country.**

### English Electric Company, Ltd.

The principal exhibit of the gas turbine division of the English Electric Company, Ltd., is one of the standard EM27P multi-purpose gas turbines. This is a two-shaft, open-cycle machine with a nominal continuous rating of 2750 h.p. at 7000 r.p.m. when operating with a heat recuperator and 2950 h.p. at 7000 r.p.m. when operating without a recuperator. It can be operated over a range of output speeds with relatively small changes in rated output and efficiency.

The compressor of this turbine has six axial stages followed by one radial stage; the overall pressure ratio is 4·8 : 1. Air leaving the compressor is ducted either direct, or via a heat recuperator, to the twin, all-metal louvred wall-combustion chambers. The gases leave the combustion chambers at 1430 deg. Fah. and enter the turbine inlet casing prior to expansion through the mechanically separate compressor driving and power turbines. These two turbines are arranged in series, each having two axial stages.

The turbines have cylindrical outlet casings with no horizontal joints, so that thermal expansion is equal in all directions and casing distortion under starting and other operating conditions is minimised. An air cooling system, using air bled from various points along the compressor, cools outer casings, bearing housings, rotor faces, charging turbine blade roots, &c. The hot gases within the turbine are conveyed, where necessary, in light inner ducts fabricated from heat-resisting materials; these ducts are mounted to allow freedom of expansion and carry thermal stresses only.

The turbine assembly forms a rigid unit which is supported at three points by rubber/metal-bonded bushes mounted on trunnions. The compact single-pass, contra-flow, heat recuperator fitted to the turbine displayed is available as an optional extra. This recuperator is of stainless steel construction, and it is stated to reduce specific fuel consumption by some 23 per cent at the expense of a slight drop in power output. It forms an integral part of the gas turbine assembly and does not materially increase the overall dimensions of the set. These gas turbines are suitable for a variety of industrial applications, such as for generating sets, pump, compressor and other drives, and a typical installation is shown in Fig. 1. The gas turbine generating set in this installation operates on drained methane from a colliery and it has a nominal rating of 2000kW.

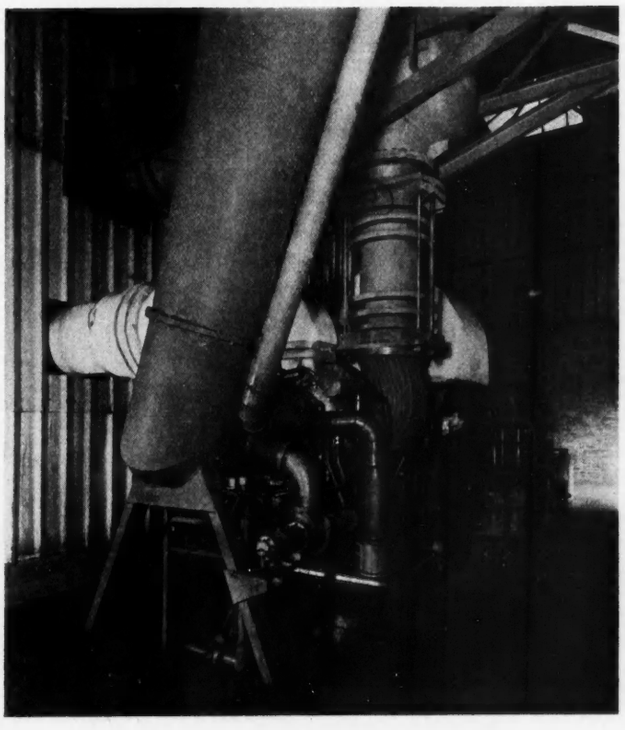


**Fig. 1—Gas turbine generating set with a nominal rating of 2000kW operating on drained methane at a colliery—English Electric**

Three equipments displayed by the oil engine division of the company include a skid-mounted drilling rig set, a traction set and a marine set. The oilfield set is fitted with an eight-cylinder V-engine of 739 b.h.p. at 900 r.p.m., and is typical of the package units with outputs of 314 to 2065 b.h.p. made by the firm.

The diesel traction set is one of seventy-three similar equipments for powering the multiple-unit train sets of the Southern Region of British Railways. It incorporates a supercharged, four-cylinder engine of the "RKT" range, with an output of 500 b.h.p. at 850 r.p.m., which is directly coupled to the generator. In this set (Fig. 2) variable-speed control is used to reduce the average engine speed over service periods with fluctuating power demands. This results in considerable economies in fuel and lubricating oil and in lower rates of wear. The governor also actuates the auto-loading device which ensures that the generator cannot overload the

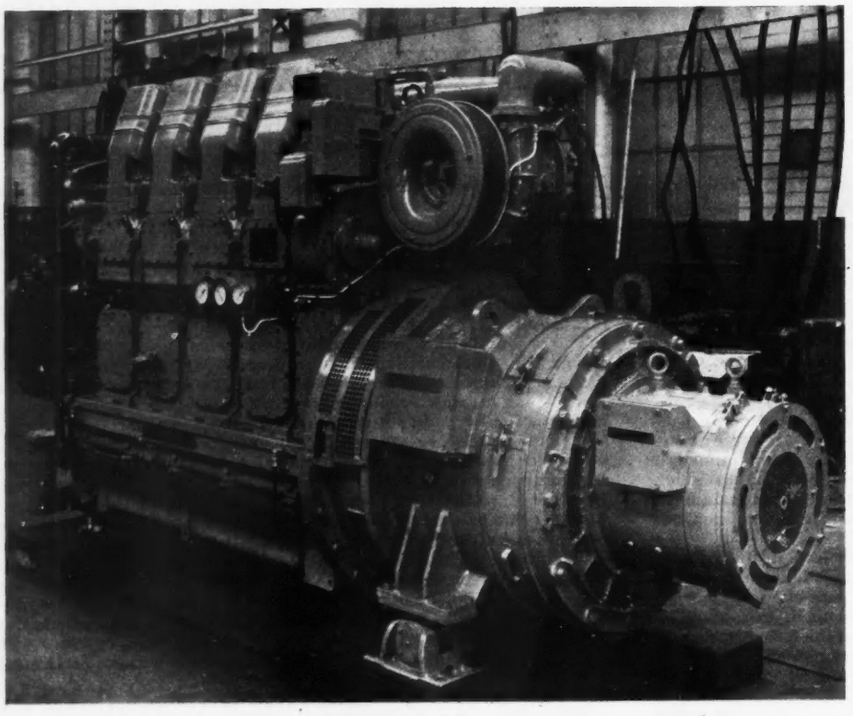


Fig. 2—Diesel traction set for Southern Region of British Railways—English Electric

engine and that full engine output is available over a wide range of locomotive speed.

Welding equipment on another of the firm's stands includes four portable, single-operator, arc welding sets, and a new continuously rated welding rectifier for hand welding which has been designed and built to meet the requirements for d.c. equipment.

Another stand is devoted to the products of the company's control and electronics department. The exhibits here include two additions to the range of English Electric r.f. induction heaters. One is a 35kW equipment designed for the heat treatment of metals: it is housed in a hammer-finish cubicle of formed steel and aluminium sheet. Forced air cooling is provided for the single BR1102 oscillator valve and other circuit components. The control circuits are designed to give regulation from zero to full load with optimum impedence matching over a wide range of work circuit conditions. This heater is demonstrated in conjunction with a laboratory-type rotate-and-traverse unit. Connection between the two units is effected by an "Axiducta" low-loss coaxial feeder specially developed to carry the heater output power to remote workheads.

The other new equipment is a 15kW r.f. induction heater, in which a conventional three-phase rectifier circuit supplies a BR179 oscillator valve. Control of its output is effected by a hand-operated variable coupling transformer. This equipment is rated for continuous output duty at 15kW, to BS1799-1952, at a nominal output frequeney of 450kc/s. Access for servicing is given by a roller shutter in one side of the cubicle.

**Russell Newbery and Co., Ltd.**

In addition to displaying products such as two marine auxiliary sets, consisting of a 100 b.h.p. "E.6" diesel driving a 50kW generator and an air compressor; a 27 b.h.p. engine driving a 15kW generator and a compressor; a 24 b.h.p. propulsion unit; and a "Husky" power pump, Russell Newbery and Co., Ltd., Dagenham, Essex, is showing a recently introduced new range of engines. Known as the "F" range it consists of three, four and six-cylinder vertical four-stroke engines, the latter being illustrated herewith (Fig. 3). The four-and six-cylinder engines are available with supercharging. The "F3," "F4," and "F6" engines have a speed range of 650 to 1200 r.p.m. and corresponding power developed by the respective engines is 43/80 b.h.p., 57/106 b.h.p., and 74/106 b.h.p. When supercharged the four-cylinder engine develops 106 b.h.p. at 1000 r.p.m., while the six-cylinder model is rated at 160 b.h.p. at the same speed.

The cylinder bore and stroke of these engines is 6in and 7¼in respectively. The crankcase is of cast iron and has long bolts which run through to the cylinder block, a construction which allows bearings, pistons, connecting-rods and the crankshaft to be removed through the open side of the engine. All valves can be removed from the cylinder head without disturbance of head or piping, and both inlet and exhaust valves have renewable guides. The valve operating gear has roller bearings. Renewable wet cylinder liners are fitted and the aluminium-silicon pistons have three compression and two scraper rings. The alloy steel connecting-rods, which are drilled for the lubrication of the phosphor bronze small-end bush, have big-end bearings consisting of a plated copper lead top half and a white metal lined bottom half. The crankshaft of 40/50-ton steel is carried on white metal lined main bearings. C.A.V. fuel pumps, one per cylinder, supply fuel through filters to pintle pattern injection nozzles, the fuel supply being regulated by a centrifugal governor. A submerged rotary gear pump provides pressure lubrication and the circuit

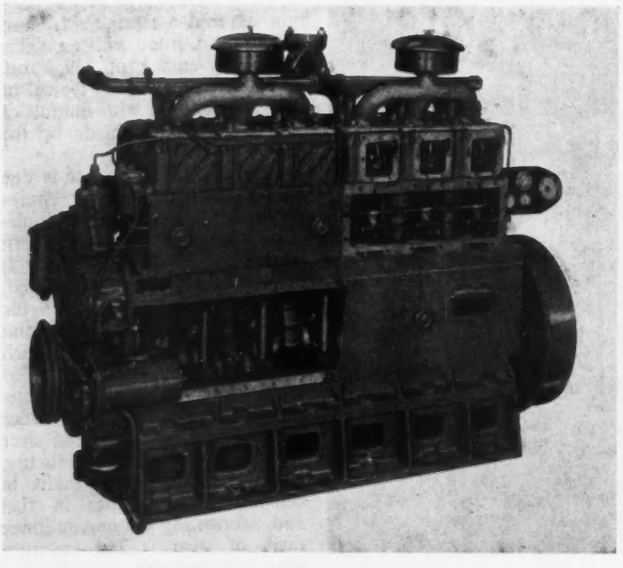


Fig. 3—"F.6" diesel engine developing 74 to 160 b.h.p. within a speed range of 650 to 1200 r.p.m.—Russell Newbery

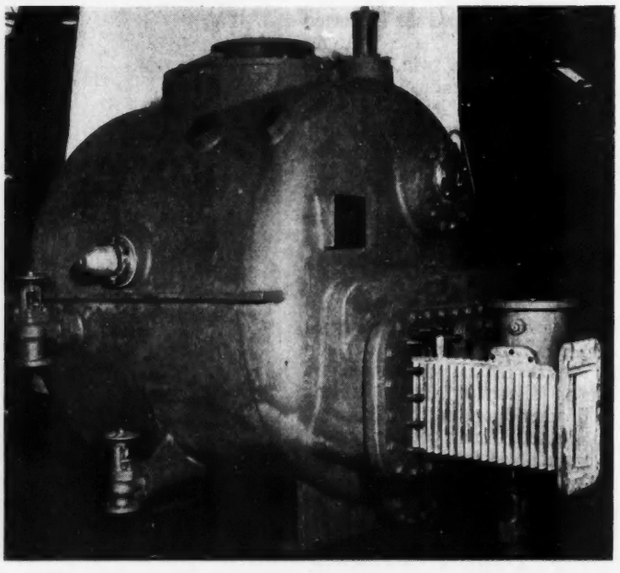


Fig. 4—Low-pressure evaporator with "Thermoflex" heating element—Weir

incorporates a water jacketed oil cooler, a primary strainer, a secondary filter, and a relief valve.

### G. and J. Weir, Ltd.

On the stand of G. and J. Weir, Ltd., Glasgow, are many examples, including working models, of this company's varied products. A modern example of an old design is the direct-acting boiler-feed pump of 1425 lb per hour capacity, while in contrast is a turbo-feed pump having an output varying from 15,000 to 19,500 gallons per hour at a discharge pressure of 860 lb per square inch. Also on view is a horizontal geared turbine, suitable for driving the cargo oil pumps of a modern tanker. This turbine of impulse design has one pressure and two velocity stages and a hydraulic speed governor. The turbine develops 730 b.h.p. at 6500 r.p.m., and 1500 r.p.m. at the output shaft when taking steam at 570 lb per square inch and 608 deg. Fah. Representative of the company's air compressors is a standard three-stage unit delivering 150 cubic feet of air per minute to 600 lb per square inch at 750 r.p.m. One of the principal exhibits is shown in our illustration (Fig. 4); it is a horizontal low-pressure evaporator fitted with a Weir "Thermoflex" heating element which is suitable for horizontal and vertical evaporators and designed to solve the problem of removing sea-scale. The element, as can be seen, is in block form with corrugated sides and is made of non-ferrous metal. These corrugations, into which steam expands, provide an extensive heating surface and even slight variations in temperature or pressure cause the element to flex. Before putting the element into operation a preliminary slight but critical thickness of scale is formed, then, with the admission of steam, the resultant flexing causes the excess scale, over the minimum critical thickness, to crack and flake off. This new design of heating element has been extensively tested in service and it has been established that an evaporator fitted with these units will run for about 1000 hours at constant output before it is necessary to close down for removal of scale from the evaporator base.

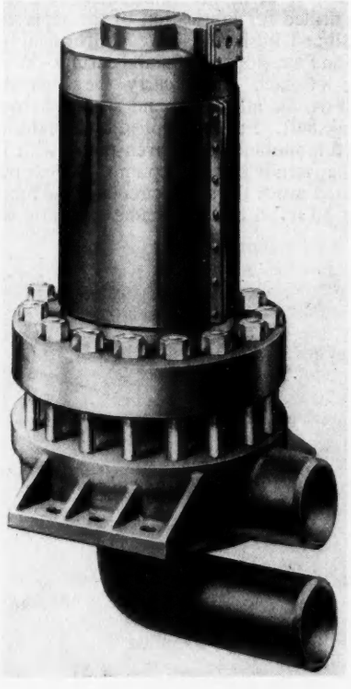


Fig. 5—"Canned" pump for nuclear power stations—Weir

Among the models shown is that of the Weir/English Electric "canned" pump which we illustrate (Fig. 5) and which has been especially developed for nuclear power plants. Another model demonstrates a modern two-element boiler feed controller by use of moving lights in the hydraulic circuits. A third model relates to the prevention of scale formation in sea-water evaporators, in which chemical treatment is related to the alkalinity of the brine. The fully automatic titration plant on the stand periodically draws and analyses brine samples and then carries out the necessary adjustment to the quantity of chemicals to be supplied to prevent scale formation.

### General Electric Company, Ltd.

Marine engineering exhibits are prominent on the stand of The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2. The display includes a typical cubicle switchboard for the control and distribution of a.c. auxiliary power on ship board; cubicle construction of this kind is used for main switchboards consisting of alternator synchronising panels, main circuit breakers and feeder switchgear and for group starter boards controlling auxiliary motors.

A special lighting demonstration on this stand shows colour change and dimming effects with "Osram" cold-cathode tubes under the control of an electronic dimmer developed from equipment supplied by the

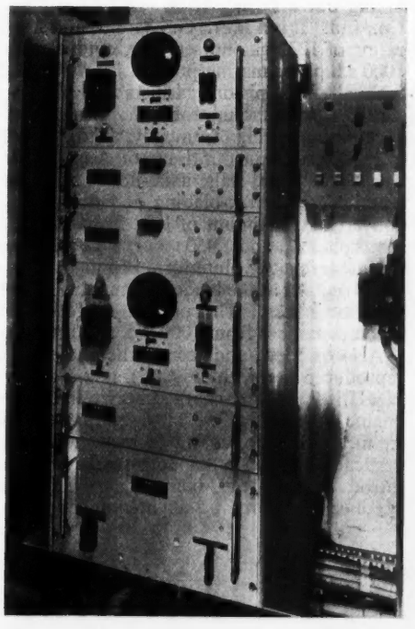


Fig. 6—Electronic equipment for dimming cold-cathode lighting installed in the "Empress of England"—G.E.C.

G.E.C. for the "Empress of England" and other ships. With this dimming equipment (Fig. 6) a range of dimming can be obtained which is substantially the same as that obtainable by resistance control of tungsten lamps. In the existing installations a small potentiometer driven by a miniature induction motor regulates the dimming by grid bias control of thyratron valves. In the latest version of the device, however, the grid bias control of the thyratrons is effected electronically instead of by a motor-driven potentiometer.

This electronic dimmer operates in conjunction with four lines of cold-cathode tubing—red, blue, green, and "De luxe Warm White"—forming an 11ft diameter circle in a cornice which is arranged to illuminate a dome. Colour changes are normally made with the red, blue and green tubes, but the "De luxe Warm White" can be added if required to produce pastel colours. The colour changes are initiated by relays, either automatically or under the control of a remote keyboard.

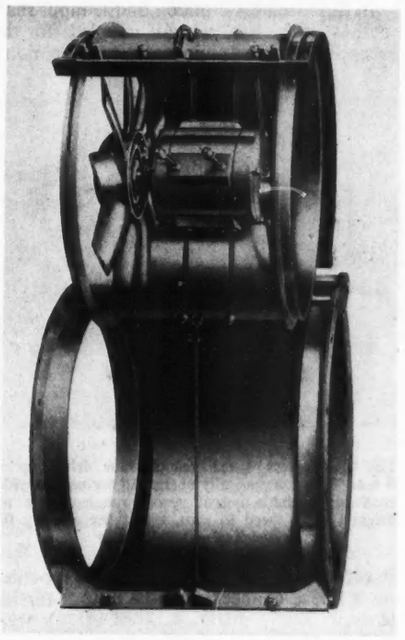


Fig. 7—"Maxcess" Aerofoil fan made by Woods of Colchester, Ltd., for marine ventilation. Here the fan is swung out and the casing "ghosted" to show the motor and impeller—G.E.C.

An associate company, Woods of Colchester, Ltd., is exhibiting typical "Maxcess" fans (Fig. 7) for marine ventilation. In this system of ventilation the fan and motor are attached to a hinged panel in the ducting and are therefore readily accessible for maintenance when the panel is opened.

### David Brown Industries, Ltd.

An extensive range of engineering equipment and foundry products is covered by the David Brown Group, of Huddersfield, and of these the gear units of new design are of interest. The firm's new series of high ratio helical "Radicon" worm reducers have been designed to accommodate high torques at low operating speeds. These combined worm and helical reduction units now provide a choice of ratios from 80 : 1 to 250 : 1 in a variety of types and sizes designed to meet numerous industrial requirements.

Each unit comprises a helical gear first-reduction assembly coupled to a standard single-reduction "Radicon" worm reducer. The self-contained first-reduction assembly is arranged to give four alternative input shaft positions which, in conjunction with the two slow-speed shaft locations, provide a choice of eight different shaft-handling arrangements. The gear ratio of the helical unit is approximately 4 : 1, different standard ratios being fitted to the final reduction unit to obtain the overall ratio required for a specific duty.

A 25-ton double-reduction coaxial gear unit with torque balancing quill drive and final quill drive, for a tower-mounted friction winder at Killoch Colliery, Scotland, is exhi-

bited. It is shown in Fig. 9 with the top cover removed in order that the arrangement of the double-helical gearing can be seen. To allow for misalignment between the gear unit and the winder friction shaft and to accommodate deflection due to braking, the sleeve on which the final gear wheel is mounted is coupled to the winder friction wheel shaft by a torsion shaft through a flexible gear coupling.

In this assembly a pinion on the input shaft meshes with two wheels coupled to the second-reduction pinions. These pinions,

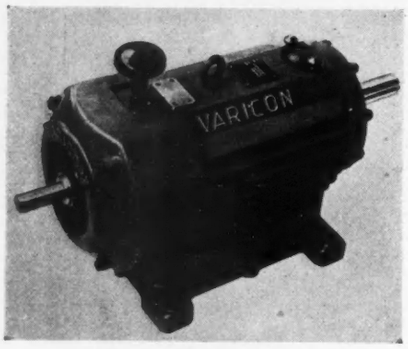



**Fig. 8—Stepless speed reducer, for drives up to 5 h.p. This hydraulically operated gear unit provides steplessly variable output speeds ranging from the original input speed to zero, whilst transmitting full rated load—David Brown**

in turn, mesh with a common wheel mounted on a sleeve connected to the output torsion shaft.

To ensure equal distribution of the load among the various gears, the drive is transmitted from the first-reduction wheels to the second-reduction pinions through quill shafts which are coupled to the first-reduction wheel sleeves by half couplings forged integral with the shafts. The outer ends of the quill shafts are connected to the sleeves of the second-reduction pinions by flexible couplings. This reduction gearing is so designed that with the 1875 h.p. driving motor running at 713 r.p.m., the speed is reduced to 56·962 r.p.m. Peak loads of 2750 h.p. (normal) and 3750 h.p. (maximum) are anticipated.

An example of current design of rail transport drives to be seen upon this stand is a final drive gearbox built for fitting in the bogies of 90 m.p.h. diesel-hydraulic locomotives, nominally rated at 2000 h.p. On these locomotives drive to each of the two bogies is from a 1000 h.p. N.B.L.-M.A.N. diesel engine, through a Voith-North British hydraulic transmission, incorporating forward and reverse mechanism, and a Hardy Spicer cardan shaft. At the final drive gearbox axle the maximum input speed is 2020 r.p.m. and the maximum input torque at starting is 110,000 lb-in. A gearbox ratio of 2·84/1 is provided and with the 3ft 7in diameter wheels of the locomotive this gives a tractive effort of 58,000 lb.

The new " Varicon " stepless speed reducer (Fig. 8) is designed for drives up to 5 h.p., and is a hydraulically-operated gear unit which provides smoothly variable output speeds ranging from the original input speed to zero and back again, whilst transmitting full rated load. The design of the gears is such that power is transmitted partly by hydraulic and partly by mechanical means. The unit comprises a hydraulic pump and positive displacement motor, which are mounted coaxially with their cylinder gears separated by a central plate. This central plate distributes oil to the separate cylinder heads and takes the reaction of the oil pressure on the pistons. Swash plates mounted in anti-friction bearings operate the pistons axially, and the output speed is controlled by a graduated regulator, which effects the required angular displacement of the swash plates.

### Brush Group

Products of the various member companies shown on the stand of the Brush Group indicate the wide range of horsepowers and engine types available for marine, industrial and automotive applications. The National Gas and Oil Engine Company, Ltd., include the first of the free-piston engines which the company has built since taking out a licence from Alan Muntz and Co., Ltd. It is a Mark G.S.34 unit and has a rating of 1232 gas horsepower, equivalent to 1000 s.h.p. for marine purposes. Associated with the free-piston gasifiers are the gas turbines manufactured by the Brush Electrical Engineering Company, Ltd., which were described in our issue of Aug. 9 last. They are multi-stage axial-flow units with reaction free-vortex blading and designed to convert the maximum of heat from gas at 4 atmospheres and 450 deg. Cent. into useful work. A volute form of intake casing and a diffuser at the blade exit annulus reduce parasitic losses. The present range of gas turbines made is from 1000 h.p. to 10,000 h.p.

Also on view, and seen in the photograph reproduced herewith (Fig. 10). is a National NMHB6T pressure-charged horizontal diesel engine developing 361 max. b.h.p. at 1500 r.p.m. and representing a new range of vertical and horizontal four-stroke engines introduced by the company. They are produced as six and eight-cylinder units, either normally aspirated or mechanically blown, giving a power range of 164 b.h.p. at 1000 r.p.m. to 438 b.h.p. at 1500 r.p.m. Engines with turbo-charger and turbo-charger with after cooler are available in vertical form and cover a power range of 240 b.h.p. at 1000 r.p.m. to 533 b.h.p. at 1500 r.p.m. while for certain applications the power available ranges from 400 to 600 b.h.p. at 1800 r.p.m.

The bore and stroke of the engine are 6in and 8½in respectively and the normally

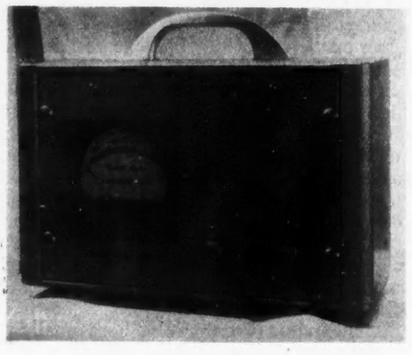


**Fig. 11—Portable vibration indicator—Brush**

aspirated engine has a brake mean effective pressure of 90 lb per square inch, which rises to 120 lb per square inch in the mechanically blown unit. For the engines with turbo-charger, and with turbo-charger and after cooler, the brake mean effective pressure is respectively 132 and 145 lb per square inch. The compression is 15: 1 in the normally aspirated unit and 13: 1 in the other designs. High-tensile cast iron is used for the crankcase and high-duty cast iron for the cylinder heads, which carry two inlet and two exhaust valves, operated from a single camshaft. The wet cylinder liners are of close-grained cast iron and chrome hardened internally. The aluminium alloy pistons have three compression rings, the top one being carried in a cast iron insert, and two scraper rings. Alloy steel " H " section stampings form the connecting-rods, which are drilled for lubrication of the replaceable small-end bush and have copper-lead shell big-end bearings. Similar bearings on each side of each crank carry the high duty, heat-treated alloy steel and surface-hardened crankshaft. Fuel is supplied by an externally fitted monobloc gear-driven pump with integral governor and a lift pump. A gear pump housed inside the sump circulates the lubricating oil to all bearings under pressure, while

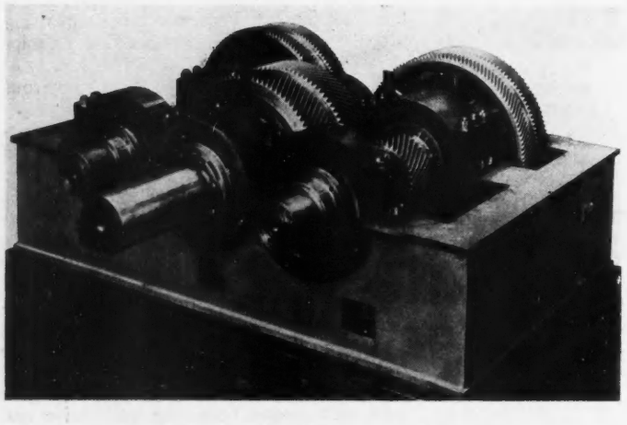


**Fig. 9—Co-axial, balanced, double-reduction gear unit, for a tower-mounted friction winder drive at a Scottish colliery—David Brown**

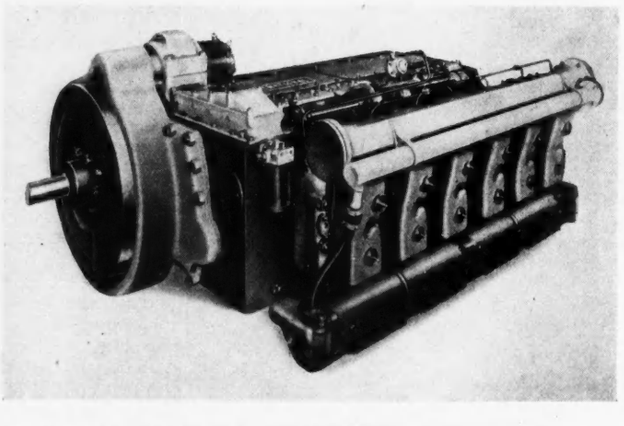


**Fig. 10—A horizontal six-cylinder diesel engine, pressure charged by mechanically driven blower mark NMHB6T—National**

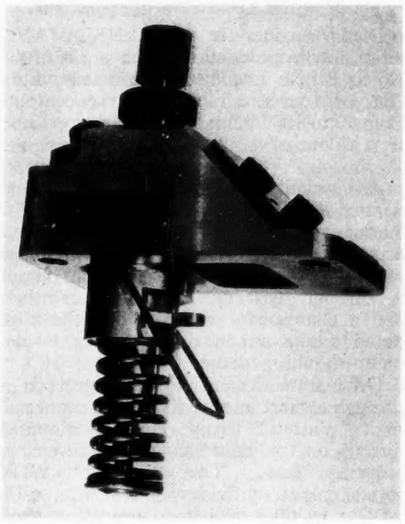


Fig. 12—Fuel pump fitted to single-cylinder, lightweight, high-speed engine—Bryce

a built-in water pump circulates the cooling water.

Another of the company's engines is a Mark F4AUM6 marine engine shown with a Hindmarch/M.W.D. 2 : 1 reverse reduction gearbox and fitted with Chadburn " Synchro-step " control. The engine, which is pressure charged, has a bore and stroke of 12in and 15in respectively and develops 874 s.h.p. at 300 r.p.m. at the propeller shaft. The largest engine on the stand is the Mirrlees KVSS.12 developing 3096 b.h.p. at 428 r.p.m., which is a twelve-cylinder vee four-stroke turbo-charged engine, with air cooler, having a bore of 15in by 18in stroke. A sixteen-cylinder model is available and is rated at 4128 b.h.p.

Representative of the new lightweight high-speed air-cooled low-power diesels introduced by Petters, Ltd., Staines, are the "P.C.2," and " P.C.4," two- and four-cylinder engines of 10 and 20 b.h.p. respectively. This " P.C." range of engines, in one, two, three, and four cylinders, have a 3in bore and stroke and develop 5 b.h.p. per cylinder at 3000 r.p.m. with a brake mean effective pressure of 62 lb per square inch and a fuel consumption of 0·52 lb/b.h.p./hour. The four-cylinder model gives a weight ratio of 25 lb per b.h.p. The heavily ribbed crankcase is of cast iron and the cast iron cylinder is held in position by through bolts, which extend into the crankcase. Cast iron is also used for the finned cylinder head. The two valves, the inlet being larger than the exhaust, are actuated by steel rocker arms operated by push-rods from a camshaft located in the top of the crankcase. The aluminium alloy pistons have an open cavity top and three compression and two scraper rings, the top compression and the bottom scraper rings being chromium faced. A lead-bronze bush is fitted at the small end of the alloy steel connecting-rod, while at the big end there is a thin-wall copper-lead-lined precision bearing. Similar bearings carry the alloy steel crankshaft, which has induction hardened bearing surfaces, and copper-lead-lined washers to take the end thrust. The multi-cylinder engines have a flange mounted Bryce block oil fuel pump, while the "P.C.1" unit is fitted with a new design of pump (Fig. 12) in which all the working parts are enclosed within the engine case.

The company also displays an electronic high-speed precision tachometer Mk.11, which has been developed to measure rotational speeds with a high degree of accuracy. Its method of operation is to count input pulses generated by a shaft mounted pick-up over a time interval. These pulses are displayed by five Dekatron counter tubes mounted on the front panel. The tachometer, which is easily transportable, is claimed to have an accuracy of ±1 r.p.m. up to 18,000 r.p.m.

A portable vibration indicator, intended for the investigation of vibration problems exhibited, is designed for use in conjunction with a velocity-sensitive pick-up head having a sensitivity of 770 mV per inch per second. The instrument, illustrated in Fig. 11, consists of a high gain amplifier using junction transisters, the output of which is integrated for direct reading of amplitude on a sensitive meter. A scale on the meter covers an amplitude of 0 to 0·100in in four switched ranges and a velocity of 0 to 10in per second in three switched ranges. Two 9V dry batteries provide the power and have an operational life of about 400 hours.

Among a number of Petter McLaren engines there is an "L.E.6." marine propulsion unit which is a six-cylinder, vertical, water-cooled engine of 5⅝in bore by 6in stroke and developing 135 s.h.p. at 1500 r.p.m. It is fitted with a self-change, oil-operated reverse and 3 to 1 reduction gearbox. Also on view is a four-cylinder, vertical, in-line, air-cooled Mark P.D.4M., engine driving through a Parsons " F " reverse and 2 to 1 reduction gearbox to deliver 29·5 s.h.p. at 600 shaft r.p.m. to 43 s.h.p. at 900 r.p.m., and represents the " P.O." and " P.O.V." range of engines having a power rating from 13 b.h.p. at 1000 r.p.m. to 96 b.h.p. at 1800 r.p.m.

### W. H. Allen, Sons and Co., Ltd.

Typical examples of the power generating plant, pumping machinery and electrical equipment made by W. H. Allen, Sons and Co., Ltd., Bedford, which are exhibited, include a complete diesel-engine-driven d.c. generator ; a large vertical double-suction circulating-water pump for power station duty ; a horizontal double-suction water-works pump ; a double-helical planetary epicyclic gear ; component parts for a large epicyclic gear unit for mine hoist duty ; an alternator ; a.c. and d.c. motors and starters.

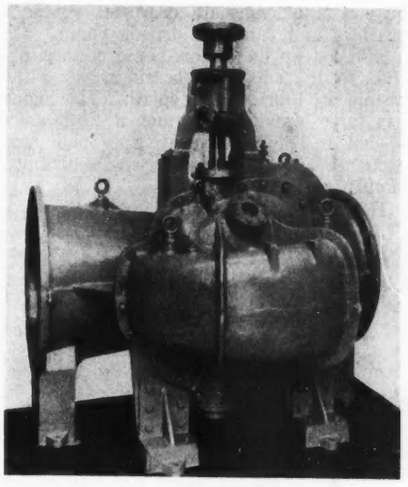


Fig. 14—Vertical, double-suction, centrifugal circulating-water pump for power station service. Duty—1,320,000 gallons per hour against 37ft head—Allen

The 410kW marine auxiliary pressure-charged diesel engine generating set on the stand (Fig. 13) comprises a five-cylinder, 450 r.p.m., 600 b.h.p. engine direct-coupled to a d.c. generator. This type of set is also constructed for power outputs of 150kW to 625kW (219 to 920 b.h.p.) and is representative of the firm's range of marine diesel generating sets with both four-stroke and two-stroke, three to eight-cylinder engines, covering powers from 75kW to 640kW. These engines are of vertical, solid-injection design employing direct combustion and arranged for cold starting on compressed air.

The four-stroke airless-injection, compression-ignition engine shown embodies an exhaust-gas-turbine-driven centrifugal pressure charger. The cylinder block is formed in a single casting bolted to a deep-section bedplate. For the medium-pressure, forced-feed system of lubrication employed, the oil is drawn from the engine sump by a gear pump and passed through a double-compartment filter and cooler before reaching any moving parts. Connections from the oil-pressure main are taken to the main

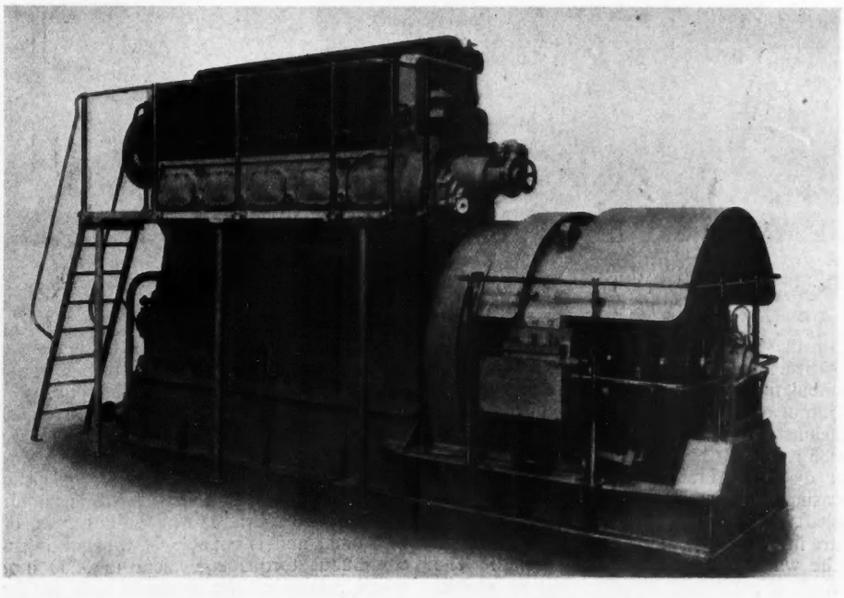


Fig. 13—Marine auxiliary pressure-charged diesel engine generating set. The four-stroke, five-cylinder, 450 r.p.m., 600 b.h.p. engine is direct-coupled to a 410kW generator—Allen

big-end and camshaft bearings, governor bearings and camshaft driving chain. Oil is also led up the hollow-bored connecting-rods to the small-end bearings, while the pistons are lubricated by splash. The engine has large water spaces and a fresh-water system is employed using a tubular heat exchanger and engine-driven centrifugal circulator.

A centrifugal governor regulates auto-

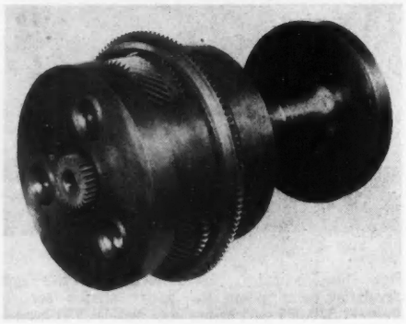


**Fig. 15—Double-helical epicyclic speed-reduction gear assembly for steam turbine-driven alternator. Ratio —4 : 1. Input shaft speed—6000 r.p.m. Output shaft speed—1500 r.p.m.—Allen**

matically the fuel supply at all loads and its adjusting gear enables the engine speed to be varied while running. The engine is fitted with motorised speeder gear to facilitate remote control from the switchboard.

The 410kW d.c. generator is a compound-wound, open drip-proof machine, mounted upon a combined fabricated-steel baseplate and has a single pedestal, white-metal-lined journal bearing which is force lubricated from the engine lubricating system.

The vertical double-suction centrifugal pump illustrated in Fig. 14 has been built for the Swartkops power station in South Africa. It is intended for condenser circulating water duty and designed for an output of 990,000 gallons of water per hour against a total head of 29ft, when running at 485 r.p.m. It has a 30in suction branch and a discharge branch of 28in. The pump casing is of gunmetal and the impeller and shaft are of stainless steel. Stainless steel sleeves are fitted on the shaft where it passes through the water spaces and stuffing boxes. The shaft is supported at either end by grease-lubricated white-metalled bearings fed by a mechanical grease lubricator which is belt-driven from the pump shaft through a worm gear. The bearings can be removed for renewal without dismantling the pump casing.

A horizontal double-suction pump exhibited has 18in diameter suction and discharge branches and is for the Warbreck Works of the Fylde Water Board, Lancashire, This pump is one of two which are required to boost a head of water leaving the service reservoir supplying Fleetwood, Lancs, when the flow is between 5,000,000 and 10,000,000 gallons of water per day, the plant being entirely automatic, with one of the pumps acting as a standby.

The pump is connected to a steel flywheel, with its own shaft carried in independent pedestal bearings. A flexible pin and bush coupling is fitted between the pump and flywheel and also between the flywheel and driving motor. The variable speed motor is rated at 21/185 h.p. at speeds of 465/970 r.p.m. The flywheel is provided for the purpose of preventing surge in the event of a failure in the power supply and of ensuring a gradual reduction in the speed of the pumping unit.

A complete epicyclic gear unit for a turbo-alternator (Fig. 15) is designed to transmit 2000 h.p. with an input speed of 6000 r.p.m. and an output speed of 1500 r.p.m. The unit consists of a sunwheel which engages with three planet wheels rotating on white-metalled spindles housed within the planet carrier. The planet carrier is secured rigidly to the low-speed shaft and rotates with it. The planet wheels also engage with the annulus rings, which are flexibly secured to, and restrained from rotating by, the gear case.

Load sharing between the planet wheels is ensured by making the annuli flexible in themselves and in relation to the gear case, connection to the latter being by way of a double gear tooth flexible coupling. The sunwheel has no bearings but is supported by the planet wheels and is connected to the turbine shaft by a double gear tooth flexible coupling.

The components for a mine hoist gear shown, comprise a 43in annulus ring, together with a sunwheel, of an Allen-Stoeckicht double-helical planetary epicyclic gear. This gear is designed for an input speed of 468 r.p.m. and an output speed of 64 r.p.m., and is capable of transmitting a continuous torque equivalent to 3200 h.p. When assembled the complete unit weighs approximately 9 tons, while the weight of the rotating parts is 4½ tons.

**North British Locomotive Company, Ltd.**

Diesel engines in the "NBL–MAN" series now in production at the works of the North British Locomotive Company, Ltd., Glasgow, cover a range of power outputs from 90 to 1000 b.h.p. A marine propulsion set with one of the "WV.17.5/22A" engines is shown. This four-stroke, six-cylinder engine is similar to that shown in Fig. 17 and is rated at 190 b.h.p. at 900 r.p.m., and for marine application is fitted with a water-cooled exhaust manifold, sea-water and bilge pumps. Drive for these displacement pumps is through gearing from the camshaft and a change-over valve enables the bilge pump to take over the duties of the sea-water pump should it become fouled.

Drive from the engine to the gearbox is through a short intermediate shaft connected to a "Vulcan" flexible coupling mounted directly on the input shaft of the reversing/reducing gear. The "Renk" WDV reversing gear provides a reduction ratio of 2 : 1, thus giving a propeller shaft speed of 450 r.p.m. The reverser is oil controlled, all the gears are constantly in mesh, and selection of ahead or astern is effected through wet plate type clutches. The gearbox generates its own oil pressure for both gear changing and lubrication, and a built-in, non-corrosive cooler is provided. The rotary valve, which controls the oil flow to the respective clutches, can be remotely controlled either by rod or cable linkage from bridge or wheelhouse.

The company is building a number of high-speed main line diesel locomotives powered by "L12V.18/21" supercharged, twelve-cylinder vee engines, and one of the engines is to be seen upon the stand. These engines are designed to deliver 1100 b.h.p. at 1500 r.p.m. on the twelve-hour rating, and each weighs about 4·25 tons. They have a fabricated steel crankcase and cylinder block, employing seven cast steel bulkheads, with steel plate side walls. The hollow crankshaft is made from a one-piece drop forging and the connecting-rods run together in pairs side by side. The cylinder heads are fitted with precombustion chambers and two monobloc fuel injection pumps driven through a gear train are situated on top of the engine. A twin impeller pump circulates water through the cooling system at 8500 gallons per hour and 4200 gallons per hour through the engine lubricating oil cooler.

The Voith design hydraulic transmission equipment has been made for a number of

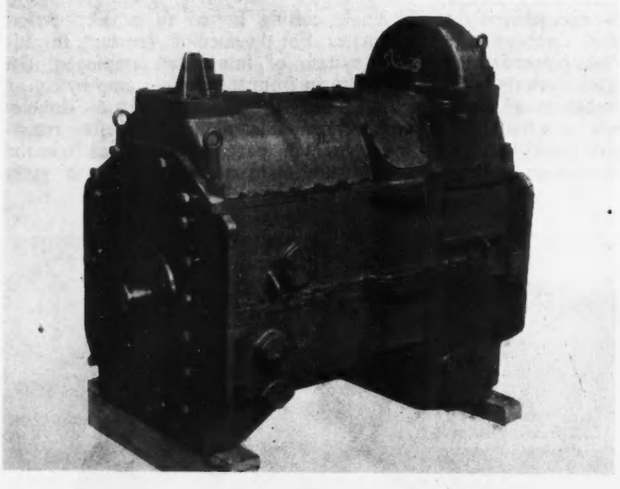


**Fig. 16—789 h.p. input Voith automatic hydraulic transmission equipment for rail traction—North British Locomotive**

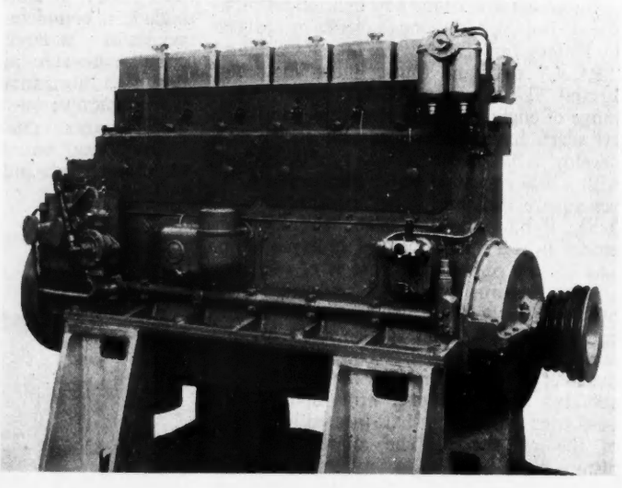


**Fig. 17—Six-cylinder, four-stroke diesel engine developing 225 b.h.p. at 1100 r.p.m.—North British Locomotive**

years by the North British Locomotive Company, Ltd., and many of the firm's locomotives fitted with this transmission have been described in our columns. Two typical transmission units of this design are exhibited, one, the "L22" type for 100 h.p. input, is shown in section. The other, for 789 h.p. input ("L37zv" type), is typical of the units used for rail traction and is illustrated in Fig. 16. It incorporates a torque converter for starting and low speeds and two fluid couplings for the medium and high-speed range. The torque converter and fluid couplings are self-contained and are engaged and disengaged by filling and emptying. This process is fully automatic, being controlled by a governor, and is dependent, in the case of a locomotive, upon its rail speed. At idling speed the transmission is disengaged. As the throttle is opened, the controls are arranged so that the first fluid circuit (in this case the torque converter) is filled before the engine speed is increased. Thereafter, the transmission governor takes full control, the following two fluid coupling circuits filling and emptying automatically in relation to load conditions or resistance at the rail. The drive is positive and cushioned by the transmission fluid, whilst the change from one fluid circuit to another is made with continuity of torque transmission and without shock to the engine.

### Harland and Wolff, Ltd.

The emphasis of the exhibits of Harland and Wolff, Ltd., Belfast, are on the electrical and marine activities of the company. Among the examples of electrical equipment are a 80 h.p., direct current, vertical spindle, enclosed ventilated, drip-proof motor with ball and roller bearings, and a 30 h.p. horizontal spindle motor with sleeve bearings. There are also a 438kVA, 400V, three-phase, 50 c/s revolving field salient pole alternator, a four-pole rotor for a 625kVA, 440V, three-phase, 60 c/s turbine-driven alternator, and an alternating current dead-front marine switchboard. On the stand is shown a model, which we illustrate in Fig. 18, of one of the diesel alternator sets which the company has built for service in the Persian Gulf and elsewhere. Each set consists of a three-phase, 50 c/s, alternator of 2600kW continuous site rating at 231 r.p.m., generating at 11kV, driven by a six-cylinder, opposed-piston, turbo-charged diesel engine. The maximum governed speed is 231 r.p.m. and the engine, which has a bore of 530mm by 1180mm combined stroke, develops 4500 b.h.p. on a twelve-hour rating. Full load consumption is 0·36 lb per brake horsepower hour and the brake mean effective pressure is 80·7 lb per square inch.

Other engine models on view include a two-cycle, single-acting, opposed piston, crosshead supercharged unit having eight cylinders of 750mm bore by 2000mm combined stroke and rated to develop 11,000 b.h.p. at 110 r.p.m.; and an eight-cylinder, opposed-piston, two-cycle, single-acting supercharged trunk piston engine of 530mm bore by 1180mm combined stroke and developing 6000 b.h.p. at 220 r.p.m.

Models of ships on the stand represent some of the wide range of ships built by the company. There is the twin-screw, turbine-driven passenger liner "Southern Cross," of 20,204 tons gross, built for Shaw Savill and Albion Company, Ltd.; the T.S.S. "Duke of Lancaster," a twin-screw, turbine-driven cross-Channel ship of 4797 tons gross, for the Belfast-Heysham night service of British Railways, and the twin-screw motorship "Scottish Coast," of 3818 tons gross, owned by Coast Lines, Ltd.

### Newman Industries, Ltd.

The explosion-proof motor (Fig. 19) exhibited by Newman Industries, Ltd., Yate, Bristol, is one of a range of explosion-proof motors from ½ h.p. to 30 h.p. for which the company has obtained approval by American Underwriters Laboratories, Inc.—an organisation responsible for testing all explosion-proof apparatus for use in the U.S.A. and for issuing certificates to approved manufacturers.

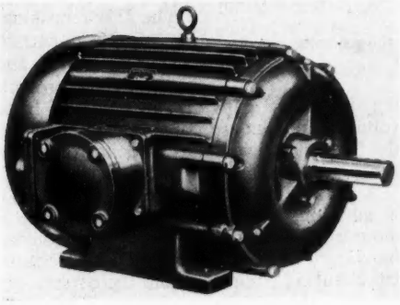


Fig. 19—Motor certified as explosion proof by American Underwriters Laboratories, Inc.—Newman

Prominent among the exhibits on this stand is the new range of Newman drip-proof motors, from ½ h.p. to 50 h.p., built to the new draft British Standard, with Class "E" insulation, and permitting 65 deg. Cent. temperature rise. This range of motors, which was introduced earlier this year, was described in our issue of March 1, page 343.

Each frame size in the company's complete range of drip-proof motors (from ½ h.p. to 600 h.p.) is displayed. The exhibits also include examples of Newman totally-enclosed motors, flameproof motors, Buxton certified for gas groups I, II and III, and vertical solid-shaft and hollow-shaft motors developed specially for deep well pumping.

### Crompton Parkinson, Ltd.

The rotating machinery shown by Crompton Parkinson, Ltd., Crompton House, Aldwych, London, W.C.2, includes a self-regulating alternator, which is representative of a range from 6 to 135kVA now in production. It has a "Magnicon" exciter, which is flange mounted in line with the alternator, as illustrated in Fig. 20. The drive is direct, the exciter being quill-mounted on an extension of the alternator shaft.

The main exhibit on the stand is a switchboard of the kind that is being supplied for the latest class of Admiralty frigates in which alternating current is used for power and lighting distribution. Compactness is a characteristic of the design. The switchboard is equipped with air-break circuit breakers and it is stated that these breakers have passed special shock tests as well as tests to determine their kilovolt-ampere rating.

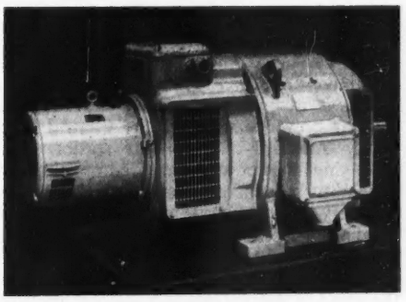


Fig. 20—Self-regulating alternator with flange-mounted "Magnicon" exciter driven from a quill on the alternator shaft extension—Crompton Parkinson

A display of the company's ship wiring cables includes some insulated with Butyl rubber.

### Rozalex, Ltd.

For many years now barrier creams have provided a valuable form of protection to workers in industry, and Rozalex, Ltd., 10, Norfolk Street, London, W.C.2, is showing some recently introduced creams which have been developed to comply with the requirements of materials and conditions over a widening industrial field. One such new cream contains a light screen medium to filter the ultra-violet fraction of light which may photo-sensitise the skin and cause such troubles as erythema and exudating dermatitis. It was originally developed to protect the skin against the effects of photo-sensitisation caused by pitch and tar, and it is now used to provide protection against flash burns

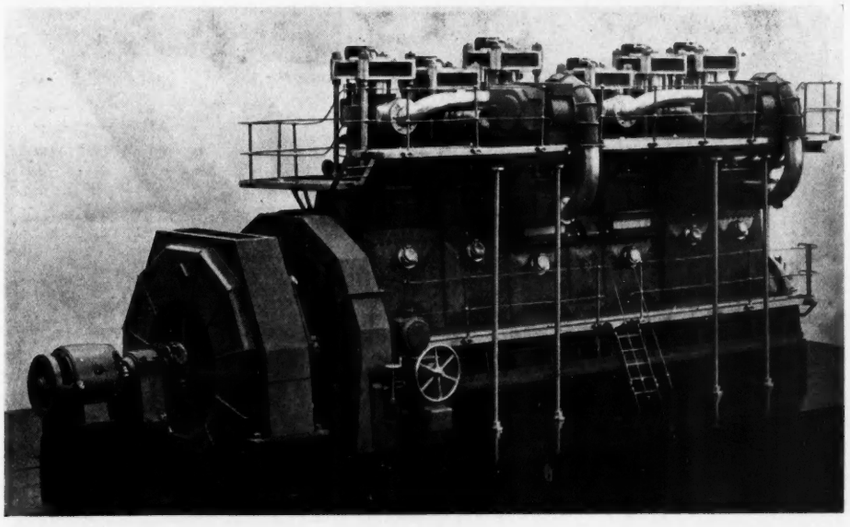


Fig. 18—Model of 2600kW alternator driven by six-cylinder turbo-charged diesel engine—Harland and Wolff

resulting from certain arc-welding techniques.

A new cream has been specially formulated for use in nuclear establishments to facilitate the rapid decontamination of protective clothing worn by the personnel exposed to radioactive materials.

**C. A. Parsons and Co., Ltd.**

The large generating equipment manufactured by C. A. Parsons and Co., Ltd., is mainly represented by a selection of photographs, but the firm has arranged as a central exhibit on its stand a completely bladed low-pressure turbine shaft (Fig. 21) for a 23MW turbo-generator set. This set is one of sixteen which the company has installed and is installing at the Calder Hall " A " and " B "

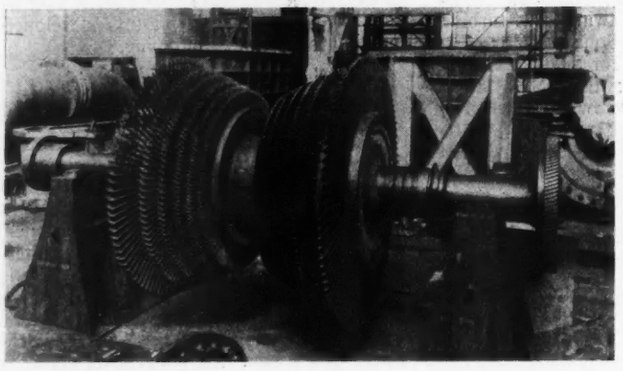


**Fig. 21—Low-pressure turbine shaft of a 23MW turbo-generator set for a nuclear power station—Parsons**

and the Chapel Cross nuclear power stations.

The Parsons Company is a member firm of the Nuclear Power Plant Company, Ltd., which is at present building the Bradwell nuclear power station for the Central Electricity Authority. For that station it is supplying the power plant comprising six 52MW turbo-generators and three 20·25MW auxiliary turbo-generators, together with the condensing plant, dump condensers, gas circulators and gas duct work.

Large coloured photographs are used on the stand to show views of recently completed 60MW turbo-generators. Artists' impressions show completed 200MW single-line machines which are under construction for the Central Electricity Authority and 200MW cross-compound machines under construction for the Hydro-Electric Power Commission of Ontario, for installation in the Richard L. Hearn generating station, Toronto, Canada. These single-line 200MW sets operate at 3000 r.p.m. and comprise high-pressure, intermediate-pressure and two double-flow low-pressure cylinders driving a single generator. The operating steam conditions are 2350 lb per square inch stop valve pressure, 1050 deg. Fah. temperature, with reheating of the steam to 1000 deg. Fah.

The 200MW cross-compound machines have a high-pressure line with high-pressure and intermediate-pressure cylinders driving a single 100MW generator at 3600 r.p.m., and a low-pressure line with a second intermediate-pressure cylinder and low-pressure cylinder driving a single 100MW generator at 1800 r.p.m. The operating steam conditions are 1800 lb per square inch stop valve pressure, with 1000 deg. Fah. temperature, reheating to 1000 deg. Fah.

One of the exhibits comprises examples of the type of blading used in these large high-pressure, high-temperature machines, both at the initial end and the exhaust end. At the initial end the blades are produced by rolling and are integral with their roots and shrouds. For convenience in handling, the blades are formed into short segments which are serrated along the root portion and secured in serrated grooves in the rotor by means of side locking strips. For the exhaust end blading the blades are rolled integral with their roots and for the last one or two rows of rotor blades the side entry form of root fixing is adopted. These blades, of vortex design, are highly tapered and twisted.

A one-twelfth scale model of a 210MVA, 15/275kV, three-phase, 50 c/s, OFW-cooled generator transformer is also included among the exhibits. In this equipment tappings of plus and minus 10 per cent in eighteen steps are arranged in the neutral ends of the 275kV windings, and the on-load tap changing equipment of the high-speed resistor type is arranged for local manual and local and remote electrical control. Cooling is by means of two 100 per cent capacity oil-water coolers and the oil pumps and pipework are so arranged that either pump may be used with either cooler, and the change over may be carried out automatically in the event of failure of supply to one pump.

The 275kV bushings are of the re-entrant condenser design and horizontal co-ordinating protective gaps are fitted. The high-voltage windings are connected in star, and the low-voltage windings in delta, the latter connection being made external to the tank.

A gas and oil-actuated relay is fitted and, in addition, a low oil level alarm device is mounted in the conservator. The connections from these, together with those from the tap changing equipment and the coolers, are taken to the marshalling kiosk. This kiosk also provides accommodation for the winding temperature indicators and the control equipment for the tap changer and coolers.

**Donald Ross and Partners, Ltd.**

The holding and positioning equipment made for the welding industry by Donald Ross and Partners, Ltd., Gatwick Road, Crawley, Sussex, includes a powered turning roll unit of 225 tons rotating capacity. This machine was specially designed for manipulating sections of the large heat exchangers constructed by Head Wrightson Teesdale, Ltd., for the atomic power station at Bradwell during welding, X-ray inspection, shot-blasting and final pressure test operations. Similar equipment has also been supplied to A.E.I.-John Thompson Nuclear Energy, Ltd., for the Berkeley power station. A " Twinner " welding head manipulator has been developed to provide improved facilities for automatic welding of internal and external seams in cylindrical vessels circumferentially and longitudinally. This manipulator is made in a number of sizes, and a fully universal model carried by a motorised bogie on rails and has steplessly variable speeds.

A wide selection of work positioners exhibited includes the " Twinner-Aronson " universal balance positioner shown in use in Fig. 22. These machines are made in four sizes of from 5 cwt to 40 cwt capacity at 12in centre of gravity. A useful bench mounted positioner recently introduced has a fully rotatable worktable, work arm and pedestal which enables work to be positioned and locked at practically any required angle. It accommodates components up to 100 lb in weight.

A portable power unit with steplessly variable speeds in both directions can be used for rotating cylindrical pipes and vessels of from 2in to 96in diameter during welding, grinding, metal spraying, painting, polishing or flame cutting. The standard machines in this range will rotate pipes from 6in to 30in diameter and, with a special adapter, pipes down to 2in diameter can be rotated. Out-of-balance pipes with elbows and manifolds can be rotated in the horizontal, vertical or inclined positions. For the rotation of vessels from 30in to 96in in diameter and up to 2 tons in weight, a simple turning roll frame with adapter driving pulley is coupled to this portable power unit.

Hydraulic platforms are made by this

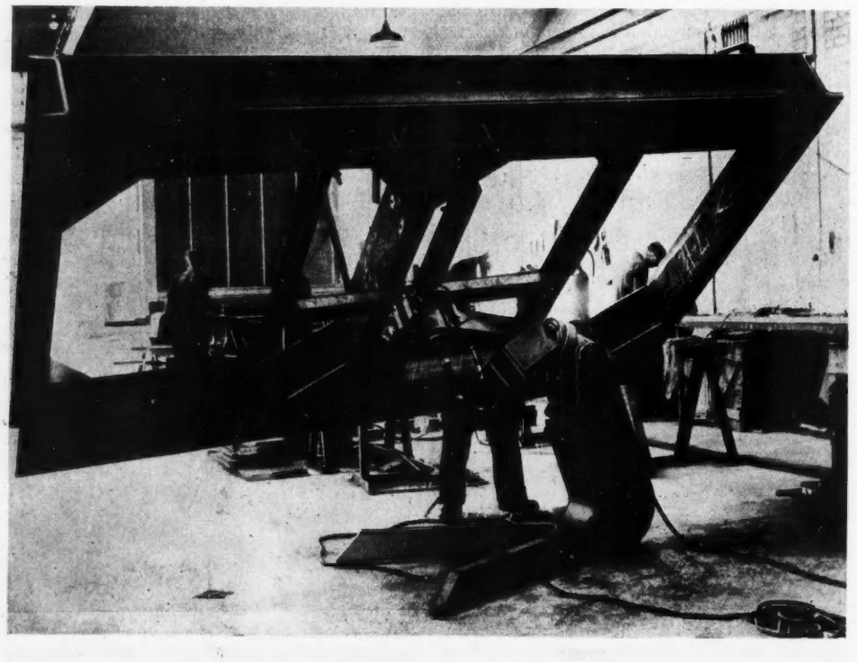


**Fig. 22—Universal balance positioner made in four capacities for work from 5 cwt to 40 cwt—Ross**

firm to provide a portable platform from which operators can work over large and bulky fabrications. Easily adjustable, these platforms have a safe-working load of 4 cwt with good forward reach. The standard platform is manually operated by a hydraulic pump, but a power-operated platform is available if required.

**Merlin Engineering Company, Ltd.**

Efficient apparatus for the calibration, testing and servicing of fuel injection equipment for diesel engines has become an economic necessity for commercial transport and other undertakings which employ the engines in any reasonable number. The Merlin Engineering Company, Ltd., of Hebble Mills, Salterhebble, Halifax, has for some years specialised in providing a comprehensive range of machines and apparatus for this purpose and some of the firm's more recent products are shown at Olympia this year.

One of the two " Calimaster " fuel pump test equipments shown is the light bench model " M.6," which was developed for the

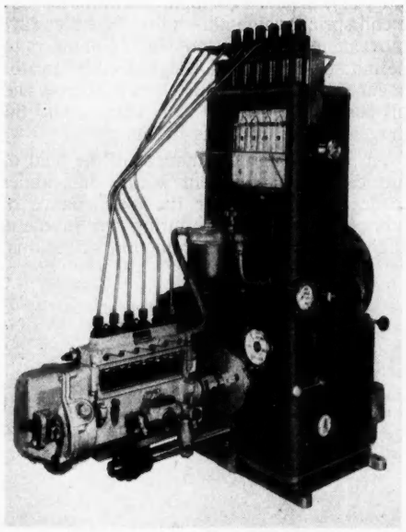


**Fig. 23—Bench mounting diesel engine fuel pump calibrating and testing machine—Merton**

use of firms mainly concerned with the popular " A," " B," " N," and distributor pumps up to six cylinders commonly used on vehicles. This machine is fitted with a high-pressure phasing system for speed and accuracy of phase angle, and is adaptable for calibrating or flow testing, phasing, timing, governor setting, checking pump leakage, checking feed pumps, &c.

A new product is the universal fuel pump calibrating and testing machine for bench mounting, which is shown in Fig. 23. It is suitable for use with a number of different makes of pumps and is intended to provide a simple, inexpensive equipment for the small commercial vehicle undertaking or service station. It can be used to test pumps having one to six elements fitted with pneumatic governors, and it has three speeds of 200, 600, and 1000 r.p.m. A set of six balanced test injectors is provided, and an automatic trip mechanism performs calibration over exactly 100, or a multiple of 100, revolutions.

For checking pumps with built-in governors, an expanding pulley variable speed control, with a range from 175 to 1250 r.p.m., and a tachometer, may be provided. Another fitment available is a fuel delivery pump able to develop sufficient pressure in the pump gallery to pass fuel through the delivery valve of any element whose plunger is below the point of commencing injection. By turning the pump by hand until such passage ceases, the commencement of injection may be timed, it is claimed, within two minutes of arc. For phasing, a scale of degrees can be clamped to the drive shaft. This system of high-pressure phasing and timing is believed to be one of the quickest and most accurate available.

The machine is provided with a paper element filter in the fuel supply line, and has a 1½ h.p. motor normally wound for three-phase, 50 c/s, 220/400V supplies. It will test all " A " size pumps, including C.A.V. and Hartford distributor pumps, " AA " size pumps and " B " size pumps, again including any " D.P.B." models, with up to 7·5mm bore plungers.

**F. Perkins, Ltd.**

The familiar range of diesel engines shown by F. Perkins, Ltd., of Peterborough, includes an industrial version of the " P3/144 " engine. This modified " P3 " engine is intended for a small power unit on road construction and contractors' plant and the lighter types of belt-driven applications.

It is of four-stroke, three-cylinder construction with a bore of 88·9mm, a stroke of 127mm, and a swept volume of 144·3 litres. With a maximum twelve-hour rating of 28·25 h.p. at 1800 r.p.m., the engine has a maximum torque of 84 lb per foot at 1200 r.p.m. One of these compact industrial engines is shown in Fig. 24.

The cast iron cylinder block is cast integrally with its crankcase and the cylinder bores are fitted with renewable high-duty cast iron liners. Spherical combustion chambers for each cylinder are formed half on each cylinder head and half on a detachable cap on the side of the engine. A forged steel crankshaft with cast iron balance weights is carried on four thin-wall lead-bronze-lined main bearings. Each of the alloy pistons has three compression and one control ring above the gudgeon pin and a second oil control ring below the pin. The camshaft is supported in the cylinder block by three bearings and actuates overhead valves through rocker gear and short tappets in the cylinder head.

An in-line fuel injection pump with a pneumatic governor is, like the camshaft, driven through gears from the crankshaft sprocket. The lubricating pump is also gear driven from the crankshaft and the centrifugal water-

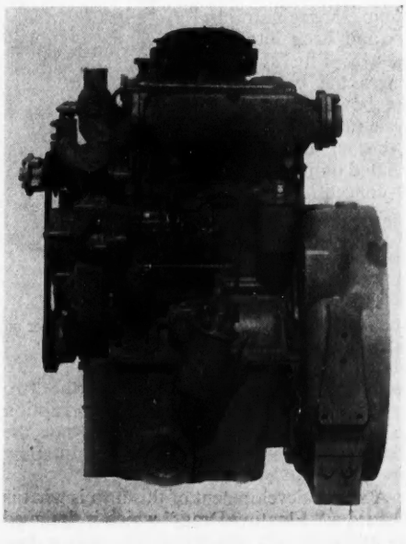


**Fig. 24—Three-cylinder industrial diesel engine with a maximum rating of 28·25 b.h.p. at 1800 r.p.m.—Perkins**

circulating pump of the cooling system is fitted to the front cover of the timing case and belt driven from the crankshaft. A 12V dynamo is fitted and electric and cold starting equipment can be provided on the engine.

**E. N. Mackley and Co.**

A new underwater light (Fig. 25) is manufactured by E. N. Mackley and Co. to a patent of the United Kingdom Atomic Energy Authority. The lampholder body is constructed of aluminium and has a sealed side cable gland entry which gives access to the connection to the lampholder and is secured in a way such that when the special lamp is screwed in position correct alignment is certain. This method of lamp location also ensures positive contact between the neck of the lamp and its spring-loaded rubber seals. The system of component assembly

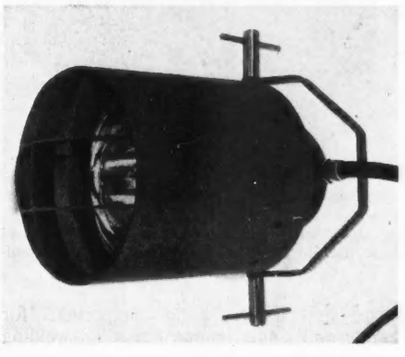


**Fig. 25—Underwater lighting fitting—Mackley**

results in complete watertightness. An aluminium guard is fitted to give protection to the lamp under working conditions and has a top grid which allows light to be projected and affords security against lamp breakage. Stainless steel wing bolts facilitate stirrup mounting and there is also a cast lug on the lampholder body for securing in position. The aluminium parts are anodised and both the structure and water sealing arrangements are capable of withstanding pressure of 1500ft head of water.

**Northern Aluminium Company, Ltd.**

Particular prominence is given to the applications of aluminium to the nuclear energy and shipbuilding fields by the Northern Aluminium Company, Ltd., and part of this firm's stand is used to show a large structure fabricated by the Fairey Aviation Company, Ltd., for the U.K. Atomic Energy Authority.

The growing use of aluminium in shipbuilding is shown by a ship's permanent awning of " Noral Industrial " pattern corrugated sheet, and a display of extruded sections developed for marine use. There is also shown a sample of " Noralduct," the rolled aluminium sheet material with integral passageways used for refrigerator cooling units, radiators and heat exchangers.

The recent addition of new production equipment at the Rogerstone works now permits the manufacture of shipbuilding plate of a size very much greater than has been available before.

The maximum available plate length of 50ft remains unchanged, but plates can now be supplied in widths up to 10ft or 12ft in the range of alloys and thicknesses normally called for in shipbuilding and general engineering. These plates are made by a fabrication technique that involves the precision welding of two pieces of plate of normal width.

### Rockweld, Ltd.

An interesting new automatic arc welding equipment has been introduced by Rockweld, Ltd., Commerce Way, Croydon, Surrey. The " Autopak " multi-purpose transformer, suitable for both manual and automatic welding, which is used with this equipment, is illustrated in Fig. 26. This is a portable

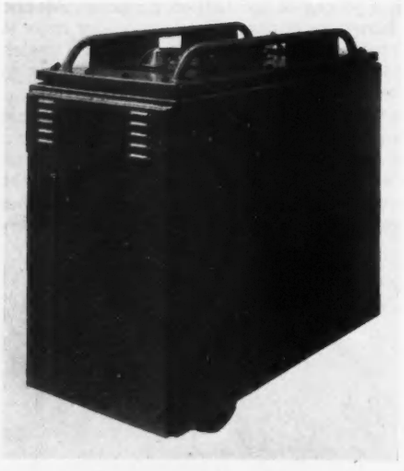


Fig. 26—Multi-purpose transformer for double and single operator, manual and continuous wire automatic welding—Rockweld

power unit incorporating components for double and single operator manual welding and for operating a continuous wire automatic welding head. It has a three-position switch by which the equipment can be set for (*a*) double operator manual working with current range 35/325A at each point ; or (*b*) single operator manual working with current range of 250/650A ; or (*c*) for running the automatic head and supplying it with currents up to 650A. On open circuit, 80V is provided for manual welding and 60V for automatic welding.

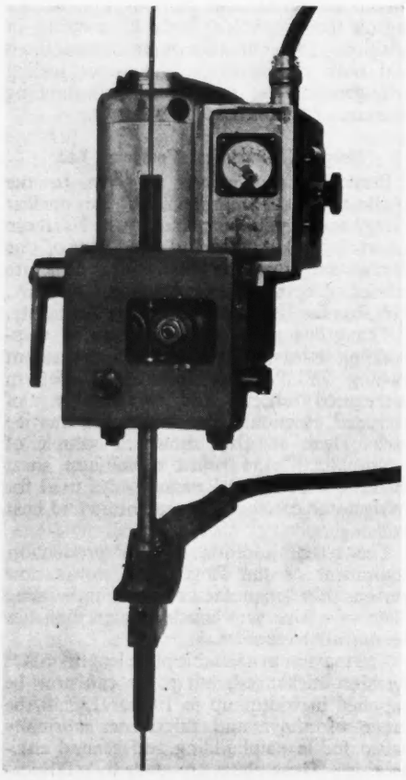


Fig. 27—Automatic welding head for use with the " Autopak " transformer—Rockweld

The " Autopoint " automatic head made for use with the plant can be seen in Fig. 27. It is a light, adaptable, readily mounted head designed for handling bare wire up to $^{7}/_{32}$in from the reel, and a maximum current of 1300A. The head can be used with the " Autopak " for welding with $^{3}/_{32}$in, $\frac{1}{8}$in and $^{5}/_{32}$in wire, or with two in parallel for $\frac{5}{16}$in and $^{7}/_{32}$in wire. In this head a double motor drive is geared differentially to the feed rolls and regulated by a circuit which is very sensitive and responsive to arc conditions. The arc is self-starting and the system is stated to be immune to variations in supply voltage. The operating controls on the head consist simply of an arc voltage regulator, an inching switch, and a running switch.

The above equipment is being demonstrated using the maker's " Detron " wires and flux granules, and there is also to be seen upon the stand an iron powder electrode known as the " Meteor, " which has recently been introduced.

### Sharples Centrifuges, Ltd.

The oil treatment plant to be seen upon the stand of Sharples Centrifuges, Ltd., Dorman Road, Camberley, Surrey, includes one of the firm's " Nozljector " high-capacity centrifuges for the purification of heavy fuel oils. In this design of centrifuge oil is fed to the bowl at the top and passes to the edge of the disc stack. Passing through the discs, where the water and solids are removed, the clean oil is discharged into the covers at the top of the bowl ; the water and dirt pass to the wall of the bowl and out through a series of nozzles. This nozzle discharge, comprising the water and dirt, plus a small quantity of oil, drops through an upper recycle tank and then through a quick opening valve to a lower tank. A float valve maintains a constant level in this lower tank by recirculating some oil, the remainder of the mixture being pumped, by means of a positive displacement pump, through strainers and back into the bowl. The sludge enters the bottom of the bowl, through recycle tubes outside the disc stack and is recirculated until sufficiently concentrated to be discarded. The sludge is quickly dumped by operating a hand valve between the upper and lower recycle tanks and a three-way hand-operated valve on the discharge side of the recycle pump. To recommence the operating cycle, the two valves are reversed. There is no interruption to the feed of oil to the machine, nor the discharge of clean oil, during this dumping operation.

A recent development of this firm is what is termed a " Floating Drag," which is designed to overcome the effects of movements and vibrations on centrifuges in marine service. In giving the reason for introducing this new device the firm points out that to avoid undesirable bearing stress and vibration the " Super-Centrifuge " rotor is suspended from the drive bearing assembly on a flexible spindle. The lower end of the rotor runs in a loose-fitting guide bushing in order to permit the rotor bottom to move and find that position which corresponds to its centre of mass. In a marine installation the constantly changing gravity component can lead to wear, unless special provision is made to restrict the movement of the drag bushing at the bottom of the bowl. In the past there has been no way of doing this without losing the advantages of the self-centring operation. The " Floating Drag " overcomes the disadvantages, whilst still retaining the benefits of self-centring operation.

Due to the low ratio of diameter to length of the centrifuge bowl, the gyroscopic effect is small and the drag allows for dynamic cushioning and the control of the movements of its bush. Control is effected by a series of special springs pressing plungers against the outside of the bush and controlling its movements. As can be seen in our drawing (Fig. 29), the bush is supported from below by a coil spring which allows for slight sideways movement against the controlling plungers to permit self-centring. A sight feed lubricator is connected to the casting by a feed pipe, and oil passes through the main casting and the drag shell into the drag bushing.

An interesting development in the field of lubricating oil treatment is the de-acidifier made by this firm for the maintenance of lubricating oil quality during use in diesel engines. Since the introduction of residual fuels for diesel engines, problems have arisen from the formation of corrosive sulphur compounds which find their way into the engine crankcase. Efficient centrifuging minimises the problem, as does the practice of doping the lubricating oil to neutralise the acids and to inhibit corrosion. However, the duration of efficacy of the doping is limited, after which the oil has to be renewed.

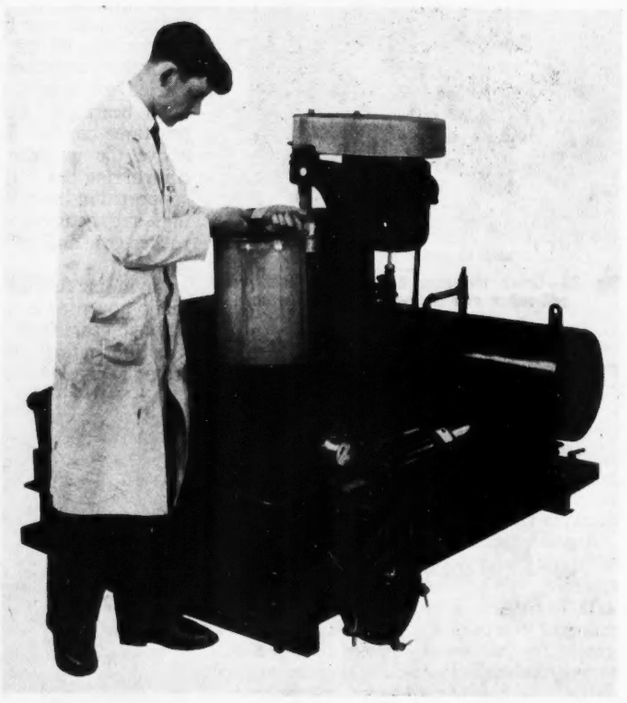


Fig. 28—De-acidifier unit with operator recharging the treating chamber—Sharples

The de-acidifier makes use of an external tank, which can be seen in Fig. 28. This tank

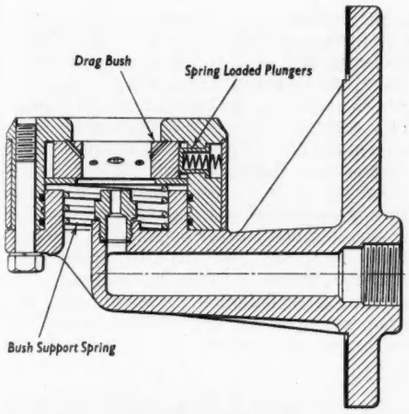



**Fig. 29—Arrangement of "Floating Drag" fitted on marine centrifuges—Sharples**

contains the treating materials in a convenient pelleted form, having a large contact surface combined with low resistance to flow. These pellets have a special binder which is insoluble in the oil and their composition is such that there is no tendency to clog up the chamber in which the treating material is housed. This makes it possible to maintain the circulation of the oil at a steady rate and eliminates maintenance cleaning problems, it being merely necessary to reload the chamber regularly with a change of treating pellets to replace those that have been consumed by the reaction.

The pellets contain alkaline earth carbonates which have the property of neutralising deleterious materials, such as mineral acids, without reacting on the additives in the oil. They are also stated to neutralise organic acids of low molecular weight (such as acetic acid and propionic acid) that may have been formed in the lubricating oil system. Finally, the products resulting from the decomposition of the metallic salts of the mineral and organic acids, formed in the lubricating system of the diesel engine, by the pellets (namely, the sulphates, chloride, acetates, propionates, of calcium, &c., and the hydroxides of iron, copper, lead, &c.), are insoluble in the oil. They can be removed in a "Super-Centrifuge" lubricating oil purifier, following the de-acidifier, as part of the complete treating system.

### Leslie Hartridge, Ltd.

A heavy-duty fuel pump test bench now made by Leslie Hartridge, Ltd., 9, Victoria Street, London, S.W.1, is intended for testing the pumps used on large marine, stationary and locomotive oil engines. The slotted bed of the machine is designed to facilitate the mounting of all makes of fuel pumps which can readily be connected through adapters to the 9in diameter coupling. Pumps under test are driven by a 5 h.p. constant speed motor through variable speed gear giving a smooth range of speeds from 0 to 750 r.p.m. Speed is recorded on a large tachometer in both directions of rotation. A balanced flywheel, which weighs about 5 cwt, is mounted on the main shaft and is graduated for spill timing purposes.

Pumps under test can be supplied with fuel either by gravity or pressures up to 150 lb per square inch. Provision is also made for lubricating the pumps at any required pressure up to 30 lb per square inch. The different types and banks of test injectors and calibrated test tubes which can be fitted to the universal machine give a range of outputs from zero up to 1000 c.c. in multiples of 100 or more strokes.

A new nozzle analyser which has been developed for the firm is shown in Fig. 30. This machine is fitted with a compressed air operated hydraulic pump, the output of which can be controlled and maintained at any rate of flow, from nil to the full demand of a nozzle orifice, for any desired period by the operation of a simple control valve. It is pointed out that this design of pump eliminates the difficulties of maintaining an even and regular flow at low fuel rates which are experienced with hand-operated pumps. It is also stated to be an improvement on power-driven cam-operated pumps with which, even at low speeds, the duration of the injection period is considered to be too short to enable a reliable observation of the functioning of the nozzle and the movement of the needle to be made.

The nozzle holder fixture, which accommodates adapters to suit various kinds of

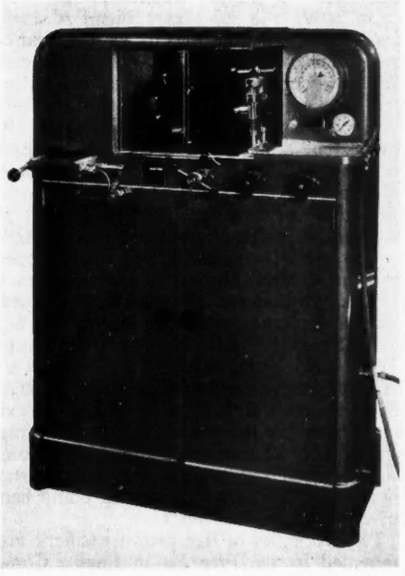


**Fig. 30—Nozzle analyser fitted with a compressed air operated pump, the delivery of which can be maintained at any rate of flow for any required period —Hartridge**

nozzles, does not incorporate any high-pressure delivery pipes or nuts. A large precision pressure gauge for pressures up to 240 atmospheres enables pressure settings, needle opening and closing pressures, dry seat tests, and back leakage tests to be accurately made. This gauge incorporates an electric seconds timing clock, which can be set to start counting at any desired pressure so that time and pressure readings can be taken simultaneously.

An illuminated spray cabinet of ample proportions, fitted with transparent sliding panels, is conveniently placed to permit observation of the spray formation of the nozzle and is ducted to a de-atomising tank, which also provides for fuel storage. A fume extractor system can be connected through an adapter on the side of the machine, and, if required, there can be supplied an attachment by which nozzles can be flushed out and cleaned with oil under high pressure.

### Drysdale and Co., Ltd.

The pumps to be seen upon the stand of Drysdale and Co., Ltd., Yoker, Glasgow, include a 7in single-stage, tank-type (drowned suction) centrifugal unit, originally developed to meet Admiralty requirements for a forced lubrication pump which was silent in operation and simple to maintain. This simple, high-speed centrifugal pumping set is illustrated in Fig. 31.

The centrifugal design reduces the components to the desirable minimum of one shaft, one impeller, one volute, two journal and one thrust bearing. The assembly is light and compact and is provided with a seating for mounting on a flange immediately below the motor stool, leaving only the motor, motor stool and discharge branch above the drain tank when installed.

The immersed tank construction avoids need for priming or the use of long suction pipes and valves. As there is no suction lift, air entrained in the oil enters the pump at atmospheric pressure instead of being expanded by vacuum; there is, therefore, less fall off in volume of oil with increased aeration. No fine strainers are required on the pump, since small solids can pass through the impeller and are prevented from entering the system by the filters provided on the discharge. Delivery from the pump is relatively independent of clearances at the lubricant delivery points, and it is capable of delivering an increasing volume of oil with the reduced resistance to flow which may develop in the life of the main machinery.

The "Capsule" horizontal axial-flow pump for transformer oil circulation shown on the stand is designed for fitting directly into a horizontal pipeline. Its compact design allows this pump to be removed from a line without spillage of oil when the valves at each end are closed.

Another exhibit consists of one of the firm's "Aquair" water ring air pumps fitted with a "Vortegon" silencer and separator. This combined silencer and separator is designed for fitting to the open discharge of the rotary vacuum pumps in duties where a low noise level is required coupled with efficient extraction of liquid from the pump discharge. The equipment consists of a vertical hexagon chamber with the air pump discharge connected to a distributing channel tangential to one of the panels of the silencer and separator body. At each corner of the hexagon a recessed channel is formed where any liquid entrained is separated by the combined action of the

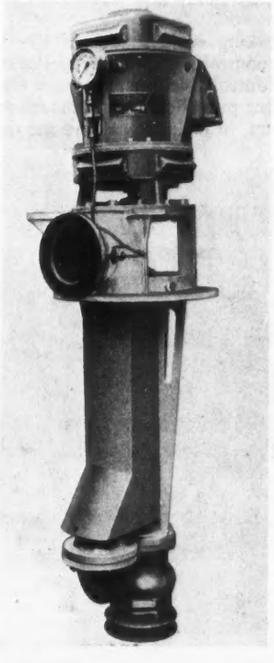


**Fig. 31—Drowned suction centrifugal pump for forced lubrication in marine service—Drysdale**

vortex produced at this corner, and the centrifugal force occasioned by the tangential velocity from the air pump discharge. Each one of these channels and corners forms a system of vortices and liquid separating ducts in series and there is a combined stripping or drying effect as the contents from the air pump discharge completes the circuit of the inner periphery of the chamber. A powerful retarding and sound damping effect, is produced by these corners and the reflection effect has an important influence in causing a reduction of the sound level. The liquid is discharged through an opening at the bottom of the silencer, while the gas rises in a spiral form with much retarded motion and sound energy and delivered in a concentrically arranged pipe with a tuned expansion box before discharging to the atmosphere.

**Associated British Engineering, Ltd.**

The exhibits of Associated British Engineering, Ltd., 37-41, Bedford Row, London, W.C.1, are representative of the wide range of products manufactured by the various companies forming the group. British Polar Engines, Ltd., of Glasgow, show one of a range of two-cycle, direct-reversing marine engines, which are built with four to nine cylinders and range in power from 640 to 1440 b.h.p. at 250 r.p.m. or 750 to 1700 b.h.p. at 300 r.p.m. The engine on view, which can be seen in the accompanying illustration (Fig. 32), is a mark M.48.M. unit having eight cylinders of 340mm bore by 570mm stroke and an output of 1500 b.h.p. at 300 r.p.m. It is shown running under its own power to demonstrate the simplicity of the two cycle system. The bedplate is fitted with cast iron white-metal-lined bearings and the cast iron cylinder block is fitted with removable close grained cast iron liners, which are free to expand longitudinally. The cast iron cylinder covers are in two parts and the pistons, of special cast iron, are oil cooled. There is one fuel pump per cylinder, supplying an automatic needle fuel valve. An opposed-piston scavenge pump is mounted and driven in tandem with the starting air compressor which is of reciprocating two-stage design. Driven from the crankshaft are the double-acting reciprocating cooling water pump, bilge pump and a lubricating oil gear pump.

A working scale model of the Lips de Schelde controllable pitch propeller is shown by the Controllable Pitch Propeller Company, Ltd. This propeller has the blades arranged in tandem, in order to achieve the minimum diameter of hub, with a high efficiency over a wide range of pitch settings and engine r.p.m.

Henry Meadows, Ltd., displays many items which present the company's policy of rationalisation in diesel-driven generating sets, covering an output from 22kW to 161kW and examples of the wide range of marine diesel engines manufactured by the company. On the stand are a 6.D.M.S. 970 " Nelson " engine of 270 b.h.p., a 6.D.M. 630 " Frobisher " engine of 130 b.h.p., and a 4.D.M. 330 " Porpoise " engine of 90 b.h.p. Also shown is the 6.D.J. 500 unit, which we illustrate in Fig. 33. This is a four-stroke, direct-injection, cold-starting, water-cooled, compression-ignition engine having six cylinders of 120mm bore and stroke. It develops 97 b.h.p. at 1800 r.p.m. on a twelve-hour rating. The compression ratio is 16 to 1, and the brake mean effective pressure at the maximum torque of 308 lb ft at 1350 r.p.m. is 92·5 lb per square inch. A single high-grade iron casting forms the crankcase and cylinder block. The three cast iron cylinder heads each cover two cylinders and carry one inlet and one " Stellite " faced exhaust valve, for which there are fitted renewable valve seat inserts cast in high chromium iron alloy. The aluminium alloy pistons have three compression rings, the top one of which is chromium faced, and two scraper rings. The " H " section, high tensile steel connecting-rods have copper lead lined steel bushes at the small ends and thin shell steel-backed copper-lead-lined and lead-indium-treated bearings at the big ends. Seven similar bearings carry the crankshaft. Fuel is delivered by a lift pump to an injection pump and solidly injected through long stem multi-hole nozzles. A gear-driven pump supplies lubricating oil at 50 lb per square inch from a wet sump of 4 gallons capacity, and the cooling system is served by a centrifugal water circulating pump belt driven from the crankshaft.

Two examples of free piston gasifiers are presented by the Free Piston Engine Company, Ltd., one being shown on the stand and one outside the main building. The inside exhibit is a G.S. 34 gasifier having an engine cylinder bore of 13·4in, a compressor cylinder bore of 35·4in and a stroke of 17·4in per piston. At the continuous maximum rating of 1250 gas horsepower the oscillations are 570 cycles per minute and the corresponding gas temperature and pressure are respectively 437 deg. Cent. and 42·5 lb per square inch. When coupled with a gas turbine and reduction gear the normal continuous rating is 1000 s.h.p. The specific fuel consumption is 0·320 lb per gas horsepower per hour and the thermal efficiency into gas 43 per cent. The external exhibit consists of a self-contained 200kW generating set in which a G.S. 75 gasifier is coupled to a seven-stage Budworth gas turbine, which drives a 200kW Allen marine generator through reduction gearing. The bores of the engine and compressor cylinders of the gasifier are 7·5in and 20·75in respectively, and the stroke is 9·5in per piston. The number of oscillations at the continuous maximum rating of 420 gas horsepower are 1000 cycles per minute and the gas temperature

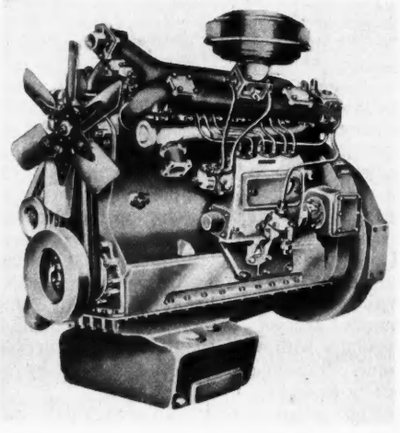


Fig. 33—Mk. 6.D.J. 500 diesel engine developing 97 b.h.p. at 1800 r.p.m.—Meadows

and pressure are 460 deg. Cent. and 45 lb per square inch respectively. The normal continuous rating when coupled to a turbine and reduction gearing is 350 s.h.p. A specific fuel consumption of 0·325 lb per gas horsepower per hour is claimed and the thermal efficiency in gas is given as 42 per cent.

Other engines shown by the group include four units manufactured by the Bergius Company, Ltd., and include a two-cylinder P.2. diesel direct-injection four-stroke engine of 10 b.h.p. at 1500 r.p.m., a mark E.2. Kelvin-Ricardo engine of 7½ h.p. at 1150 r.p.m., and a 33 h.p. at 1000 r.p.m. J.3 unit. A K.4 series III engine, of 88 h.p., is shown with a Bergius 2 to 1 water-cooled reduction gear, giving no fore and aft movement of the propeller shaft and transmitting a propeller speed of 375 r.p.m. Another item of interest in this engine is the slow-running water pump and the redesigned water system. Another member of the group, H. Widdop and Co., Ltd., exhibits various components of the engines made by the company and a model of the G.M.B.6 pump-scavenged, direct reversing, two-stroke, six-cylinder engine having a continuous rating of 726/798 b.h.p. at 300/330 r.p.m.

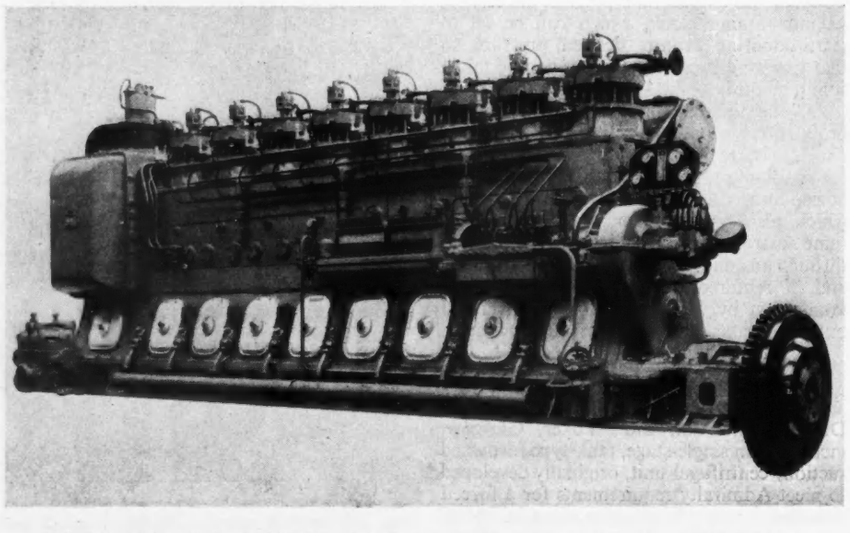


Fig. 32—Eight-cylinder M.48M. marine engine of 1500 b.h.p. at 300 r.p.m.—British Polar

**A. Reyrolle and Co., Ltd.**

A new design of 11kV, 500MVA horizontal drawout airbreak circuit breaker, in which cast resin is extensively used for insulation, is being shown by A. Reyrolle and Co., Ltd., Hebburn, Co. Durham. It is available in normal current ratings up to 2000A and the busbars are rated at 2400A. In the fixed portion of the switchgear (Fig. 35) the orifice insulators are of epoxy resin ; the insulators associated with the controlled circuit embody an insulated platform and stem for the mounting of the current transformers. Epoxy-resin insulation is also used for the busbars and all joints are insulated

with a filled polyester resin, which can be broken down and remade on site. The voltage transformer is also cast in resin and is plugged into orifice insulators above the current transformer chamber with access to it for isolation from the back of the panel. The cranked plug isolating contacts with cast resin insulation on the circuit breaker portion can be rotated through 180 deg., which permits the breaker to be plugged into normal circuit, feeder-earth, or busbar-earth positions. The circuit breaker is solenoid operated, and sandwich-type arc chute plates are used in which an iron sucker-loop is

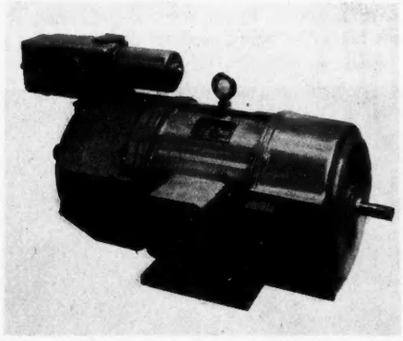


**Fig. 34—Variable speed a.c. commutator motor fitted with pilot motor for remote electrical speed control—Reyrolle**

moulded between plates of refractory material, to give effective arc control without the use of coils to energise an external iron circuit.

On the same stand there is a representative selection of Reyrolle variable-speed a.c. commutator motors with outputs ranging from 5 h.p. to 60 h.p. including examples of direct handwheel, remote mechanical, and remote electrical methods of speed control. The one illustrated in Fig. 34 is fitted with a pilot motor for remote electrical speed control, and it has a continuous rating of 10/2·5 b.h.p. at 1500/375 r.p.m. on a 440V, three-phase, 50 c/s supply. Various examples of single-operator welding sets are also displayed with their control and starter units mounted above the machine frames, and a twin-operator welding generator is included with fine regulator controls mounted in separate cases for remote control. All the welding sets have drooping-voltage characteristics, their maximum welding ratings ranging from 175A to 425A with open-circuit voltages of 70V.

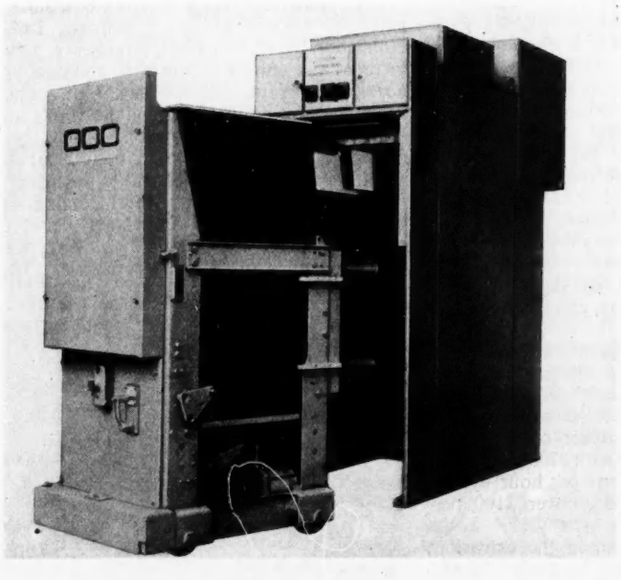


**Fig. 35—11kV, 500MVA, air-break circuit breaker in which cast resin is widely used for insulation—Reyrolle**

### Hamworthy Engineering, Ltd.

A series of screw pumps in sizes up to a maximum capacity of 100,000 gallons an hour is now being made by Hamworthy Engineering, Ltd., Poole, for handling oil fuel, cooling water and lubricants in engines, and pumping viscous liquids such as fats and emulsions which have reasonable lubricating properties. In these pumps the screws are designed so that completely enclosed chambers are formed between the threads and as the screws rotate these chambers move forward in an axial direction without creating turbulence. The screws are hardened and ground on their contacting surfaces and on standard units are carried at each end on special bearings which are lubricated by the pumped fluid under full pumping pressure. A spring loaded mushroom head relief valve may be fitted and this is adjusted to operate at 10 per cent above normal working pressure. The maker states that these screw pumps, one of which is shown in Fig. 36, may be installed in any position—horizontally, vertically or inclined, and they are available with foot or flange mountings.

The firm's new "A.V.P.16" centrifugal pump is now made in a range for capacities up to 3350 tons per hour at 30ft head. This split casing design pump is rigidly mounted in a fabricated steel frame. Its shaft is fitted with renewable phosphor bronze sleeves and is carried in a pair of ball bearings at the top which serve to maintain the axial location of the shaft and impeller. The lower bearing situated below the impeller comprises a phosphor bronze sleeve keyed to the shaft and working on a gunmetal bush. The packed gland incorporates a lantern ring which is connected to the pump volute to maintan a supply of liquid under pressure and serves to prevent the ingress of air.

If required a liquid ring primer can be fitted to this form of centrifugal pump. In this primer the rotor revolves in a water-filled elliptical casting and completes two suction/delivery actions in each revolution. It operates in conjunction with an air escaping chamber and a float-operated valve mechanism

The compressors made by the firm are represented by two machines. The two-stage "2TM6" water-cooled compressor is primarily intended for starting air duties on ships and is made in a number of sizes for capacities between 35 and 270 cubic feet per minute of free air at pressures from 250 lb to 450 lb per square inch. A "2TL5A" machine on the stand is the largest of the air-cooled compressors made by the firm and is designed to deliver between 90 and 140 cubic feet per minute at pressures between 100 lb and 200 lb per square inch. On this machine the inter- and after-coolers are combined in one block mounted transversely, and a fan which is belt driven from the crankshaft delivers a continuous blast of air through the casing.

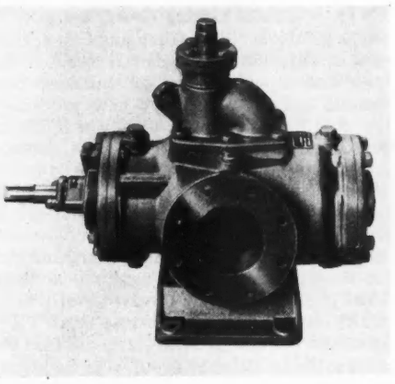


**Fig. 36—Screw pump for self-lubricating liquids. Made in capacities up to 100,000 g.p.h.—Hamworthy**

### Keelavite Rotary Pumps and Motors, Ltd.

The principal exhibit of Keelavite Rotary Pumps and Motors, Ltd., Allesley, Coventry, is a 1-ton hydraulic winch powered by a variable-speed drive, giving a maximum operating speed of 80ft per minute. An inching control is incorporated and the winch drum is driven by a gear hydraulic motor from a packaged power unit. Speed control, including inching when hoisting or lowering, together with both dynamic and static braking, is controlled by a single lever adjacent to the winch. The hydraulically-operated braking system can only be released during hoisting, when the load is already under the control of the hydraulic motor.

The hydraulic power and control equipment shown includes pumps and motors with displacements up to 10 cubic inches per revolution and pressures up to 2000 lb per square inch, although units can be supplied up to a maximum displacement of 40 cubic inches per revolution at 2000 lb per square inch. Hydraulic cylinders shown cover bores of from 1in to 6in, with the choice of foot, flange, trunnion or clevis mountings. There is also a representative number of pressure and flow control valves, and directional valves which can be operated either mechanically, electrically, or by a servo system.

### Pilkington Brothers, Ltd.

Some applications of glass as a protective material provide an interesting display on the stand of Pilkington Brothers, Ltd., St. Helens, Lancs. Three kinds of viewing windows which afford protection against various radiations are to be seen. One is a mock-up of a viewing window used in nuclear research at Harwell. It is 3ft 6in high by 2ft 6in wide and is built up of thirty-six laminations of 1in thick stabilised lead glass. Another, slightly smaller window with thirty plates of 1in clear white polished glass, is typical of the design used in hospitals to protect the staff operating a linear accelerator from dangerous radiations.

Discs of Schlieren plate glass which are used in the observation windows of wind tunnels enable accurate photographic records to be made as well as providing means of visual observation of the models. Other kinds of glass exhibited include toughened glass to withstand thermal shock, tinted selective transmission glass, diffuse reflection glass, one-way vision glass, glass linings to prevent corrosive and erosive wear, toughened industrial protective glass and glass insulators.

### Self-Changing Gears, Ltd.

The products of Self-Changing Gears, Ltd., now include not only gearboxes but other transmission units, such as clutches, converters, and couplings. A new product is the R.R.E. 1 reversing unit which, by incorporating two epicyclic trains, obtains forward and reverse selection solely by means of brakes mounted on the casing ; a reduction is afforded in each direction. It can be seen from Fig. 37 that the power is passed into the sun wheel of the first train, and that the output carries the meshing annulus. Thus closing the front brake to arrest the planet carrier provides reverse gear. The first and second clusters are coupled by uniting the front brake drum with the second annulus ; thus when the rear brake is engaged, stopping the second sun wheel, the first planet carrier is geared to the output and a step-down forward drive obtained. It will be seen that plain bearings and spigot bushings are employed and driven at high speed in some cases, and positive lubrication by a separate pump is proposed. The brakes are air actuated; each brake anchorage has a deep threaded housing but, since this box is not allowed to make a "hot shift," no adjustment is required. The unit is intended for railcars and locomotives.

Also shown on the stand are the simple converter-coupling built under licence from Schneider M.F. Corp., U.S.A.; the combined fluid coupling and centrifugal friction clutch shown at the Commercial Motor Exhibition and described on page 471 of our issue of October 5, 1956; the marine coupling box to harness two power units to a single screw, and the V.S. automatic control system for epicyclic transmission, which was referred to in our issues of January 18 and June 28 this year.

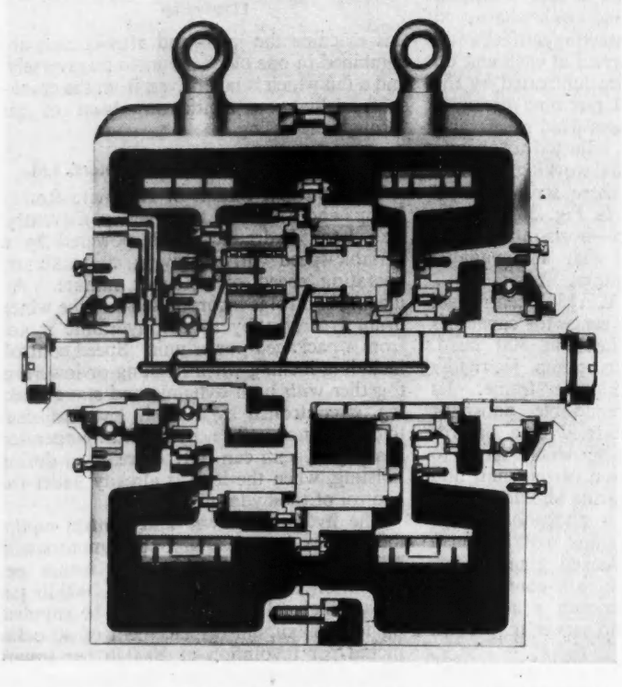


Fig. 37—Two planetary clusters controlled by band brakes afford reduction gears in either direction in this railway unit : they are interlocked against being changed when the vehicle is moving—Self-Changing Gears

### The Gas Council

An exhibit on the Gas Council's stand is the Incandescent Heat Company's "Equiverse" controlled-atmosphere furnace, the general principle of which has already been described in THE ENGINEER of November 4, 1955. This furnace incorporates a rapidly reversing regenerative system, providing a flow of uniformly heated air at a temperature approaching 1000 deg. Cent. (the degree of pre-heat regarded as necessary to give a non-scaling atmosphere). The entirely metallic matrix used in the equipment is said to permit reversing cycles to take place in from a half to one minute, so avoiding the temperature differentials of more conventional regenerative practice. The highly conductive regenerator elements pick up heat very rapidly when the flue gases are passing through them. These regenerator elements release their heat very rapidly to the primary combustion air when the system reverses.

Among the advantages claimed for the furnace in its application to a forge are : (*a*) the short time required for recovery after charging a cold load ; (*b*) the improved throughput ; (*c*) the reduced consumption of fuel ; (*d*) the uniformity of atmosphere (no stratification), and (*e*) increased die life. These advantages are said to arise from : (i) automatic control of gas composition ; (ii) preheating of combustion air to ensure working temperatures up to 1300 deg. Cent. ; (iii) introduction of secondary air into the flue gases to complete combustion ; (iv) recirculation of flue gases to improve the heat transfer coefficient by increasing gas velocity in the regenerators, and (v) use of the metallic regenerators.

The use of these furnaces is said to be advantageous in many other processes, rolling and extrusion being given as good examples. As an instance of the economies that might accrue, the maker cites a steelworks furnace dealing with 100 tons per hour. A saving of 2½ tons per hour by the reduction of scale would recover £100 per hour—perhaps £500,000 in a year. Scale cannot be tolerated at all in the extrusion process, it is pointed out, and the "Equiverse" system applied in this case is claimed to be cheaper to install and run than either salt baths or induction furnaces with specially prepared atmospheres.

The small furnace prepared for the exhibition (Fig. 38) is considered to be more of a research tool than a production unit. It is thought that there may be a number of industrial research establishments that could make use of such a furnace to investigate the value of heating in a reducing atmosphere. The maker emphasises that, while highly reducing atmospheres are obtainable, regulation is possible to give any ratio of carbon monoxide to carbon dioxide from zero (i.e. complete combustion) to 15 per cent. If required, the furnace could also be operated to give oxidising conditions, but the particular advantages of the system are claimed for the highly reducing mode of operation.

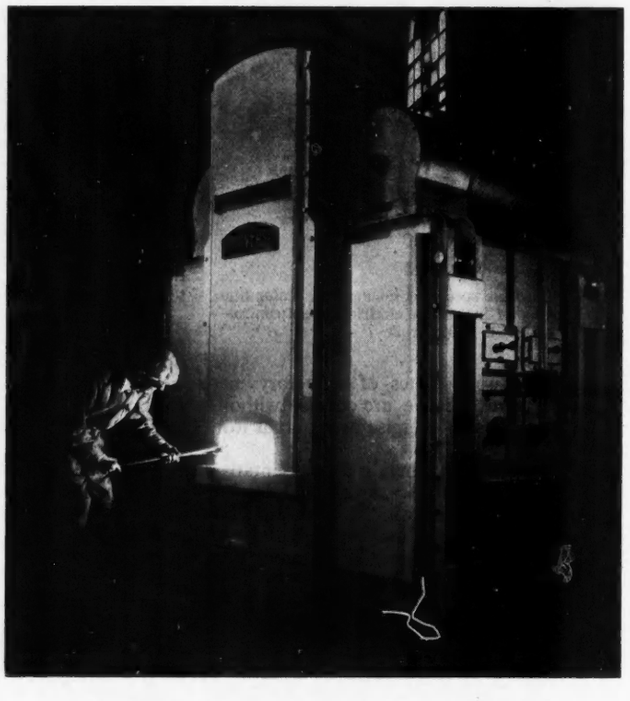


Fig. 38—"Equiverse" controlled-atmosphere furnace incorporating a rapidly reversing regenerative system—Incandescent

### Service Electric Company, Ltd.

The industrial hot air blowing equipment made by Service Electric Company, Ltd., Honeypot Lane, Stanmore, Middlesex, now includes a re-entrant heater with a maximum nozzle temperature of 900 deg. Fah. This heater can be fitted to any of the firm's air blowers or to a normal shop airline connected by a flexible hose to deliver air at ambient temperature to the end of the heater.

In this design of heater, the incoming air is preheated by being circulated between concentric tubes before finally passing the heating element to the delivery nozzle. The

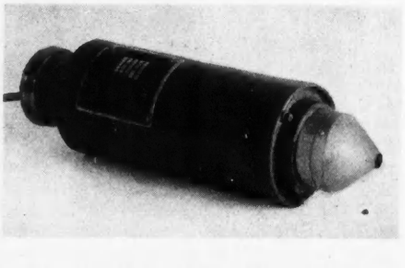


Fig. 39—Re-entrant heater supplying a blast of hot air up to 900 deg. Fah.—Service Electric

passage of incoming air down the outer section of the heater keeps it relatively cool. The heater shown in Fig. 39 is fitted with a ¼in nozzle, but the outlet can be any size up to 2in diameter and, if required, fitted with a 2in B.S.P. adapter. Heaters are supplied with elements for standard loadings of 1kW, 2kW or 3kW.

**Bristol Aero-Engines, Ltd.**

A new class of fast patrol boats for the Royal Navy is to be powered by the "Marine Proteus 1250," an example of which is seen in Fig. 40. This engine is a derivative of the civil aero-engine, and includes none of the features essential to good efficiency at low loads, so that it should

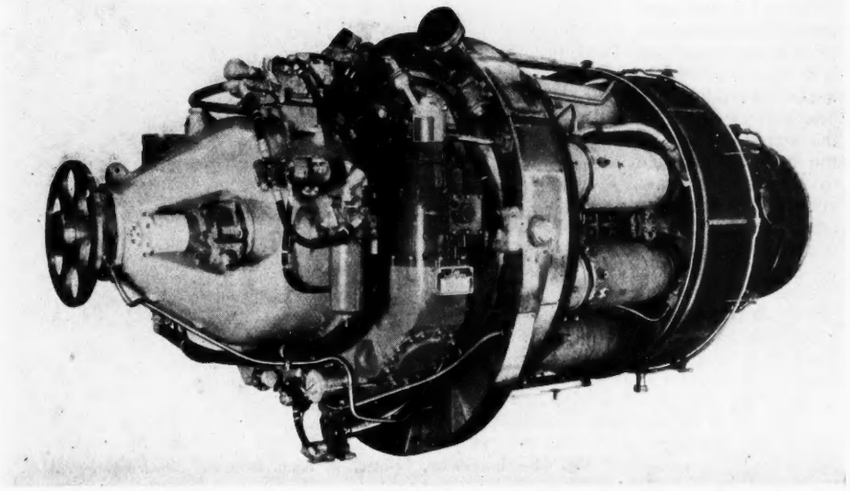


**Fig. 40—3500 h.p. marine "Proteus" engine seen from the drive shaft end, with combustion bay and turbine shields removed. The shaft coupling is on the left, the air intake is on the right beyond the combustion chambers; note the water spray round the intake—Bristol Aero-Engines**

be regarded as a boost engine except where, say, three are installed in one craft. It does, of course, have the characteristic advantages of lightweight engines of withstanding rapid starting up and abrupt shutting down. A 40W barring motor in tandem with the electric starter of the turbine can be used to prevent Brinelling of the ball and roller bearings on vessels which have a diesel cruising engine.

Corrosion resistance has been increased in the marine engine, the intake casting being of aluminium alloy instead of magnesium; all the compressor blades are stainless steel, while the first stage nozzle guide vanes are given a ceramic coating, which resists attack by sodium sulphate or sodium chloride (diesel oil is the intended fuel). At the output end of the engine there is a primary reduction gear, able to transmit the ½ hour rated output of 3500 h.p. continuously and reduce the speed from 11,000 to 5000 r.p.m.; this is built by W. H. Allen, Sons and Co., Ltd., on Stoeckicht principles. The only fixed parts of the mechanism are the fine white-metalled spindles on which the planets run on polished bores. Each planet has two identical rows of teeth along its length, and these teeth alone support the sun wheel and the annulus. On the rear end of the sun wheel there is another ring of teeth engaging corresponding teeth inside a coupling ring; this ring is axially deep so that it does not locate the pinion radially, and the far end engages with teeth inside the power turbine drive flange. Oil is sprayed on to the inner surface of the sun wheel and passes through radial drillings to lubricate not only the meshing teeth but every tooth of the coupling: the oil also runs into the coupling to lubricate each tooth at the rear end. Couplings of similar conception take the drive off the ring gears without constraining them. The oil pump is driven by either the power or compressor turbine shafts, so that the propeller may be allowed to watermill with the gas generator stationary (unlike the "Coupled Proteus," this engine does not have a clutch, and over 100 h.p. will be absorbed at half speed). A secondary reduction gear will of course be required, an arrangement that allows utilisation of the exhaust thrust being to employ an Allen vee-drive as illustrated in model form on page 26 of our issue of January 4, 1957. A heat shield surrounds the turbine and another the combustion bay; exhaust ejector action is used to draw air from the forward engine-room, through the two large openings at the top in the illustration, over the hot parts of the engine. The great area of the air intake annulus allows the after engine-room to be used as a plenum chamber, so that it remains cool. The forward engine-room contains the fuel and oil pumps, coolers, dynamos and other ancillaries. Maintenance on an engine such as this is relatively light, and consists mainly of washing salt off the compressor blades by injecting distilled water into the intake while idling.

The engine gives a continuous output of 2800 h.p. at 60 deg. Fah. ambient with a consumption of 0·66 lb/hour/h.p. and an exhaust thrust of 460 lb. At a temperature of 80 deg. Fah., 8 per cent of shaft horsepower will be lost; in cold conditions an increase may be expected, but a maximum fuel control limits the output to 14 per cent above standard. Testing of the engine has included the addition of salt water to the fuel.

**Radio Heaters, Ltd.**

A new induction shaft hardening machine which has been introduced by Radio Heaters, Ltd., Eastheath Avenue, Wokingham, Berks, can be used with any of the firm's "Radyne" induction generators which are made with power outputs up to 150kW and in frequency steps from 1 kc to 5 Mc/s. This vertical traverse hardening machine is designed to handle components up to 4ft long, 6in diameter and weighing up to 60 lb.

In its simplest form the machine (Fig. 41) consists of a single vertical traversing bed with centres between which a component of up to 2ft long can be accommodated. Provision is made for the rotation of the component whilst it is being traversed, the actual traverse bed comprising a linear ball race slide on which the centres are mounted and driven by a pneumatic/hydraulic system. If required, the unit can be provided with an additional bed on which are mounted two adjustable centres between which components up to a maximum length of 4ft can be accommodated.

The r.f. work coil or concentrator is mounted on the traverse bed and the component is hardened by traversing the work coil or concentrator. The equipment can be used for the simple progressive hardening of shafts, when the speed of traverse can be controlled from 0–120in per minute. Dwell hardening can be done with single-speed control, or with two-speed control, both speeds being separately adjustable. It can also be used for dwell and progressive hardening in reverse, such as is required when hardening flanged shaft-like components.

The machine is built up on a rigid steel angle framework, suitably panelled and provided with access doors to the various presetting controls. For setting up the machine for progressive or dwell hardening, stops are provided on calibrated rods so that the plant can be set up for any number of dwell positions or for progressive hardening for any desired length of shaft. Quench and process timers are provided to control the dwell hardening and quenching cycles; and there are control valves for the three separate speed controls.

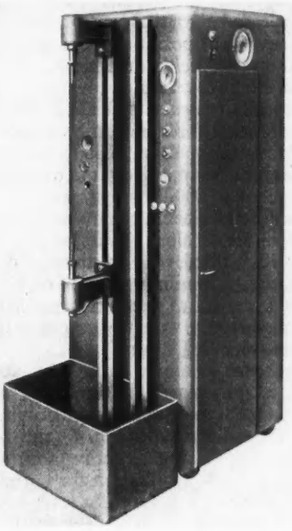


**Fig. 41—Induction machine for hardening long shafts. Controls are provided for progressive and dwell hardening—Radio Heaters**

The hydraulic system of the machine is controlled by pneumatic valves and consists essentially of an oil cylinder, the piston of which is connected to the traverse carriage, and two separate oil reservoirs. The oil is ejected from one reservoir, via the operating cylinder, to the other reservoir, the motive force being provided by the pneumatic system. To set the hydraulic/pneumatic system for the various processes selector valves are provided so that the necessary pneumatic control circuit can be switched into operation by the positioning of pneumatic valves. The necessary auxiliary electrical equipment for controlling the r.f. generator is also included in the cabinet unit. The power supply for operating this

plant is normally fed from the r.f. generator, and an air supply of 60 lb per square inch is required for the operation of the traverse unit.

A quench tank is provided to one side beneath the traverse beds to collect the used quench water.

### Clarke, Chapman and Co., Ltd.

The exhibits of Clarke, Chapman and Co., Ltd., Victoria Works, Gateshead, include a number of cargo winches and associated deck machinery.

A model of a constant tensioning mooring winch is on view (Fig. 42). It is a steam-driven unit having a centre barrel and two warping ends, designed to maintain a minimum specified tension in the mooring wire, as determined by the size of the vessel and the mooring conditions. Build up of tension in the wire causes the winch to pay out the wire and, conversely, will automatically heave in the wire when the tension eases. Normal operating procedure consists of tightening the mooring wire with the winch in double purchase until the tension in the wire is in excess of the specified pull. At this point the change over will be made to single purchase, the steam valve opened, the brake released and the control lever set to the " heave in " position, the action of the winch thereafter being automatic. A typical duty of a 6¾in by 12in size winch in single purchase and using steam at 125 lb per square inch is to wind in the mooring wire to maintain a minimum pull of 4000 lb and, should the tension build up, to hold the wire until the load reaches 15,000 lb, at which point the winch will render back to prevent any further increase in the tension. A larger winch, the 11in by 12in, fitted with an automatic valve, will maintain a minimum tension of 16,000 lb and hold up to a maximum of 60,000 lb before paying out wire to prevent a further rise in the mooring strain.

Also shown in model form is an example of an a.c. spur-geared squirrel-cage motor-driven cargo winch and topping unit combined. As can be seen in Fig. 43, the topping unit, used for raising, lowering and holding the cargo derrick, is fitted on the barrel shaft and it is driven by means of a lever-operated cast steel jaw clutch. When the derrick is in the required position, the pawl bar is engaged in the rack and the clutch is withdrawn, leaving the winch free for cargo handling. An electric interlock is provided, which ensures that the winch cannot be started in the lowering direction if the clutch is engaged at the same time as the pawl bar is in the rack.

An " Autocon " winch on view is a remote-controlled contactor-operated machine having a deck-mounted pedestal controller, which can be sited in any convenient position. A wide speed range for hoisting and lowering is available for all loads, but maximum speed on the last step in each direction is limited by automatic discrimination to safe values. For tensioning the slack rope or landing a heavy load, there is a specially slow-speed skip. The compound-wound motor is similar to the standard unit, but has a special field winding, consisting of the normal series turns and full-strength shunt and control windings. The hoisting circuit is a straightforward resistance control with series diverter on the last step giving high speed for light hook and light loads. On the first hoisting step the shunt coil of the compound-wound magnetic brake is not energised and the brake will not lift clear. The current carried in the series winding of the brake is sufficient to ease up the brake and allow the motor to creep, and this is useful for tightening up slack rope before lifting. The lowering circuit arranged for potentiometer control gives four nearly constant-speed steps for all loads. The first gives a very slow speed, useful for landing a heavy load, the motor being used as a dynamic brake; as soon as the load is landed the motor stops and the rope remains taut. A " pilot relay " on the last lowering step discriminates between light and heavy loads, and on all lowering steps the motor is connected as a shunt machine.

### A.C.V. Sales, Ltd.

Two marine and three industrial oil engines are shown as typical of A.E.C. products. The 9·6-litre, continuously-rated, 100 b.h.p. marine engine, which is exhibited complete with a 3 : 1 ratio reverse/reduction gear, is of left-hand design. It incorporates a thermostatically-controlled fresh-water cooling circuit, heat exchanger, lubricating oil filter and cooler and twin fuel filters. A similar engine included in the display is arranged for ships' auxiliary services.

A 7¾-litre, six-cylinder, industrial engine, developing 78 b.h.p. at 1500 r.p.m., is illustrated in Fig. 44. This engine, the maker's type AV470G, has a bore of 112mm and a 130mm stroke. The engine casing casting incorporates the cylinder block and top half of the crankcase, and is fitted with renewable push-fit wet liners. Two cylinder heads are connected by a detachable air inlet manifold, which can be reversed to enable the intake of air from either the front or rear of the engine. Overhead poppet valves are operated from the camshaft through flat-faced tappets and push-rods. Bearing caps located by dowels and retained by set bolts in the main casting carry the seven main bearing crankshaft. The pistons, of aluminium alloy, have an offset, straight-sided toroidal cavity in the crowns and each is fitted with three compression and two scraper rings.

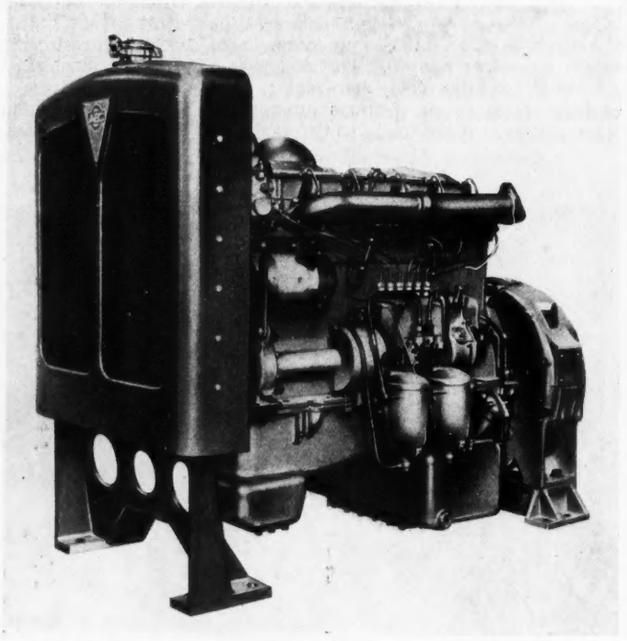
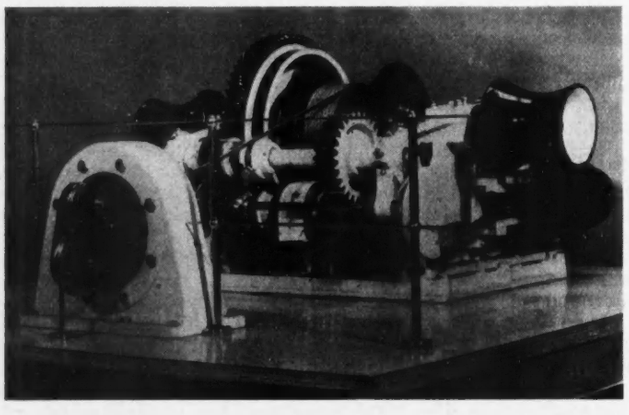
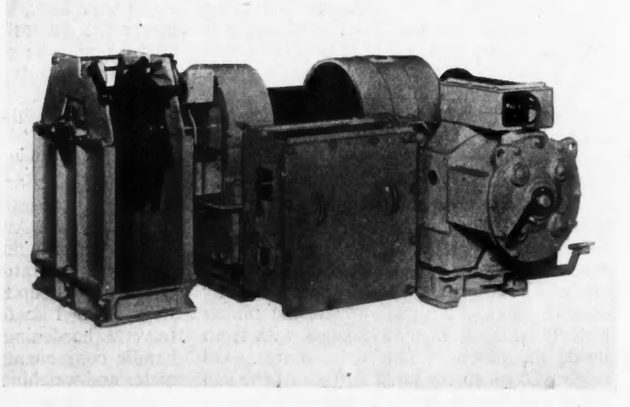


Fig. 44—Six-cylinder, 7¾-litre, 78 b.h.p. industrial diesel engine—A.E.C.

The timing gear of the engine comprises a simple train of four helical gears situated at the front. Lubricant is supplied by a gear pump and delivered at high pressure to the bearings and timing idler gear, and at low pressure to the valve gear. An independent scavenge system draws oil from the sump well, passes it through a heat exchanger, and returns it to the sump reservoir.

(*To be continued*)





Figs. 42 and 43—(Left) Model of a constant tensioning mooring winch. (Right) Model of electric cargo winch with derrick topping unit—Clarke Chapman

# Industrial and Labour Notes

### British Export Trade

An article drawing comparisons in the world export markets and the achievements of British industry in *Bulletin for Industry* states that in no major commodity group did the United Kingdom match the average increase in world trade last year. Some interesting comparisons are given in connection with the major industries. It is shown that, whilst world machinery exports rose by 18 per cent during the year, this country's exports rose by 9 per cent. Machinery exports from both Germany and the United States increased by over 20 per cent in that period. In transport equipment world exports increased by 20 per cent in general, whilst those from this country increased by 19 per cent. In this connection it is pointed out that British car exports dropped by 7 per cent, but that there has been a sharp recovery this year. A rise of 10·8 per cent in world exports of chemicals was shown in 1956, but those of this country only increased by 4·9 per cent. Metals and manufactured metal goods exports from this country increased by 11 per cent, as compared with a general world rise of 17 per cent: in this field the United Kingdom generally held its share in world trade, and it is considered that the total figures would have been more satisfactory had there not been a sharp fall in the exports of arms and ammunitions.

The most satisfactory export fields for the United Kingdom were North America and Continental O.E.E.C. countries. United Kingdom trade with Germany, a country usually thought of only as a competitor, increased by over 20 per cent in both directions. The expansion of total United Kingdom exports by less than the average was mainly due to the failure to secure an increase to the sterling area which takes about half the U.K.'s total. United Kingdom exports did well in Latin America and rose very fast to the Soviet bloc; but these are still very small markets for the United Kingdom. The area pattern of United Kingdom trade in 1956 showed more concentration than in earlier years on the rapidly expanding industrial markets and less on the primary producing countries.

Of the United Kingdom's main competitors, United States exports increased by more than the average to all areas except two. Germany did better than the average in all markets and particularly well in North America and "other countries."* Japanese exports to "other countries" increased by 54 per cent, and there were also increases in exports to Europe and North America. The exports of Continental O.E.E.C. countries other than Germany increased by less than the average in all markets except the overseas sterling area.

### Overseas Trade Corporations

New legislation providing for the establishment of a system of overseas trade corporations is summarised in a booklet, "The Overseas Trade Corporations and Other Provisions of the Finance Act, 1957," published by the Federation of British Industries. There has been frequent criticism in recent years of the effect of United Kingdom taxation on companies operating overseas, since a company managed and controlled in this country has been subject to United Kingdom tax on its total profits wherever they arise and irrespective of whether profits earned abroad are brought to Britain or retained overseas for investment there. The new system provides that a company managed and controlled in the United Kingdom but operating wholly overseas will not be liable to United Kingdom tax on its trading profits until these profits are distributed. The investment income of such a company, on the other hand, will remain liable to income tax and profits tax in the normal way. The F.B.I.'s summary is intended to assist companies which are interested in the expansion of activities overseas. It points out that may companies will wish to avail themselves of the relief which the Act affords, though others will find that it involves disadvantages which outweigh any benefit to be secured.

*Principally the dependent overseas territories of the Continental O.E.E.C. countries, and non-sterling Middle and Far East Countries.

### Operational Research

An international conference on operational research is to take place during the course of next week at Oxford. The conference has been organised by the operational research societies of the United Kingdom and of America, and by the Institute of Management Sciences. Following an opening address of welcome by the chairman, Sir William Slater, on Monday, technical sessions will be in progress throughout the week, grouped under the general headings of "Common Items," "Methodology," "Applications," and "Development of Operational Research"; about thirty-five papers have been submitted and will be discussed at these sessions. On Tuesday afternoon, however, the conference will have a choice of "panel meetings" of specific subjects such as "education and training," and "forecasting future needs and technique." On the last day of the conference, Friday, September 6, colloquia on operational research activities have been organised, such as on road transport (Road Research Laboratory), computers (Northampton Polytechnic), and fuel and power (C.E.A., London).

### Employment in 1956

The Ministry of Labour and National Service has published its report for the year 1956. The report, in effect, consists of a review of the year as it affected employment and the labour situation generally. Statistics of civil employment and unemployment, and of manpower in the Forces, are listed and commented upon, and the various services of the Ministry are reported upon. These services include the Labour Exchanges, training and welfare of various kinds, and resettlement of the disabled. The Ministry's work in the field of labour relations is also reviewed.

The post-war expansion in industrial production and also in productivity was halted in 1956, it is noted, and remained approximately as in 1955. The "total working population" increased slightly and stood at 24,087,000 at the end of the year, the numbers in civil employment and the Forces, respectively, being 22,989,000 and 761,000 at that time. The number of unemployed averaged 257,000 throughout the year. There were more stoppages of work arising from industrial disputes than in 1955, but considerably fewer working days were lost. The figure of 2,083,000 working days lost through disputes was the lowest since 1952.

There was some easing in the demand for labour during the year, affecting mainly semi-skilled and unskilled workers, mostly in manufacturing industries. The Ministry reports a considerable measure of success in redeploying redundant labour, especially in the motor vehicle and certain other manufacturing industries, by co-operation between employers and labour exchanges. Within the basic industries, the general decline in manpower was arrested in 1956.

Surveys of the manpower position in various industries are given in the report. Some other matters with which the Ministry was concerned during the year were promotion of employment amongst older people, resettlement of ex-regular members of the Forces, and extending part-time working. The Piercy report on the resettlement of disabled persons was published during the year, and the Ministry continued to make a major contribution to the work of the International Labour Organisation.

### Technical Manpower

One of the services whose functions in 1956 are explained in the Ministry of Labour and National Services Report is the Technical and Scientific Register. An unsatisfied demand for most classes of qualified scientists and engineers continued throughout the year, it is stated. Employers requiring civil engineers were inclined to be more selective, but there was a strong demand for graduates in all branches. During the latter part of the year there was some decline in vacancies for electrical engineers in light electrical engineering. The vacancies notified to the Register, and the vacancies filled, were, respectively, 6725 and 1567.

A survey of qualified scientific and engineering manpower was completed during the year. In the early part of 1956 there were 56,000 scientists and 79,000 engineers in this country. An increase of 18 and 30 per cent, respectively, was expected in the next three years, and the supply needed to be increased by about two-thirds by 1966 and doubled by 1970, it was concluded.

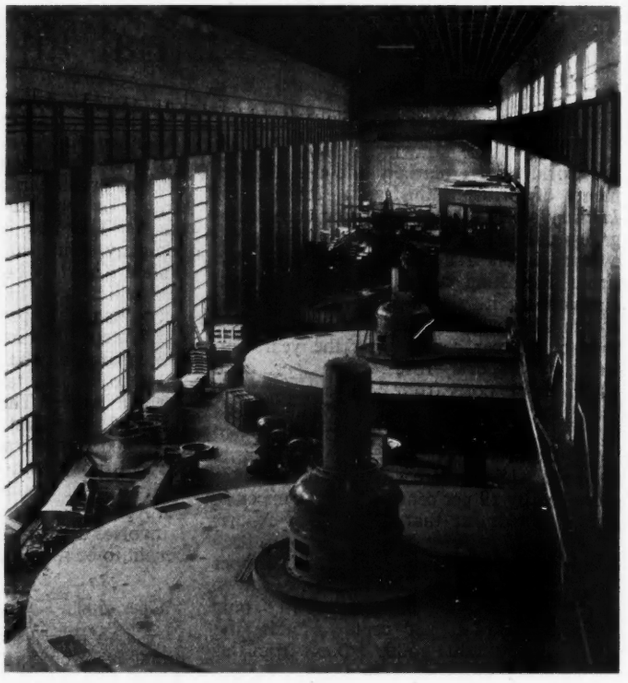
### Productivity in British Industry

The current issue of the monthly *Bulletin for Industry* issued by the Treasury shows that productivity is rising in this country again, and that in June last the index of production was again at the peak reached at the end of 1955 and some 3 per cent above the level at the end of 1956. Following the drop in civil employment last year—which continued till March last—the figures for June showed a rise of 118,000, to bring the total of employed persons in this country to just over 23,000,000. Less short time was worked in June than in January, 1957, and less than in the previous June, whilst the level of overtime worked was about the same as the year before. An analysis of labour statistics, states the *Bulletin*, showed that in the first half of the year there was a growth of pressure on labour supplies slightly greater than would have been normal at that time of the year. The rise in employment which took place in many of the capital goods industries during 1956 appeared to have slowed or stopped.

# Development of the Grand Canal d'Alsace

## THE STAGES FESSENHEIM AND VOGELGRUN

*The erosion of the river bed of the Rhine between Basle and Strasbourg during the later part of the last century almost halted navigation on that part of the river. The desire to remedy this state of affairs, and the growing need for electricity, led to the building of the Grand Canal d'Alsace which, as originally planned, was to have followed the course of the Rhine from Kembs to Strasbourg, producing 6300 million kWh of electricity per year.* The latest station to come into service, Fessenheim (illustrated here), will be completed this year, and will be followed by Vogelgrün in 1960.*



BETWEEN Basle and Strasbourg, a distance of about 100km, the level of the Rhine decreases by about 100m. Before the carrying out of Colonel Tulla's regulation scheme by France and the Duchy of Baden (1840–1860), inundations were frequent and the course of the river was constantly changing. Regulation removed the flood danger, but by shortening the course of the river by about 100km, the current was increased to the extent that serious erosion was the result. On the average, erosion proceeded at the rate of 4cm to 6cm per annum, but in some places—for instance, at Neuenburg—much higher figures, up to 6m, had been recorded by the end of the century. Navigation was first hampered, then completely interrupted, owing to the appearance of sandbanks and rocks. In 1903, the Swiss, Rudolf Gelpke, drew attention to the problem by his famous voyage, in the tug "Justicia," from Strasbourg to Basle. A plan by Alsace-Lorraine and Baden for a canal between Kembs and Strasbourg was approved by the Central Commission for the Navigation of the Rhine in 1909. The Treaty of Versailles empowered France to construct the Grand Canal d'Alsace. Switzerland joined the Rhine Commission in 1921; at that time, France had already subscribed to the principle that the proposed canal should have the same legal status as the river itself.

In its resolutions of December 16, 1921, and May 10, 1922, the Central Commission of the Rhine gave its approval to the French project, which provided for international control of navigation. Detailed conditions were set out in the Commission's resolution of April 29, 1925.

A concession for the hydro-electric exploitation in the Swiss frontier region was granted to the French concern Energie Electrique du Rhin (Société des Forces Motrices du Haut-Rhin) in 1925, and this was followed two years later by the French concession for Kembs.

After construction, which took from 1928 to 1932, Kembs barrage and power station were taken into service, but the world economic crisis, and later the outbreak of war, stopped further work. In 1940, and again in 1944, Kembs was damaged in the fighting, and was not put back into commission until 1945. Preparation for the second stage, Ottmarsheim, were made by Energie Electrique du Rhin from 1946 onwards. When the French electricity undertakings were nationalised, Electricité de France took over the project.

In 1948, the Rhine Commission agreed to the raising of the speed of the current at Kembs from 0·70m to 0·90m per second, which increased the water intake into the canal to 1080 cubic metres per second. The speed in the lower stages remained at the 1925 figure of 1·20m per second.

Finally, the French law of February 19, 1950, entrusted Electricité de France with the task of continuing the Grand Canal d'Alsace, each stage forming the subject of a separate concession. On the basis of this law and of earlier decisions of the Rhine Commission, Electricité de France drew up a plan which provided for seven stages between Kembs and Strasbourg, as outlined in Table I.

The catchment area of the Kembs barrage amounts to 35,930 square kilometres, of which 1000 square kilometres are lakes, and 700 square kilometres are glaciers. The largest recorded flow (1876) was 5700 cubic metres per second, the minimum flow (1921) was 300 cubic metres per second, and the mean flow is 1060 cubic metres per second.

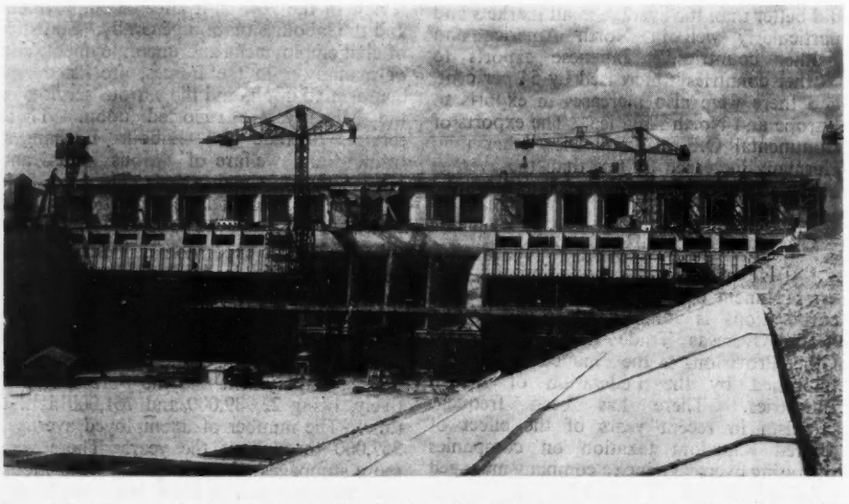
The assistance afforded to shipping by the

TABLE I—*Grand Canal d'Alsace: Principal Data**

Total annual generation = 6300 million kWh

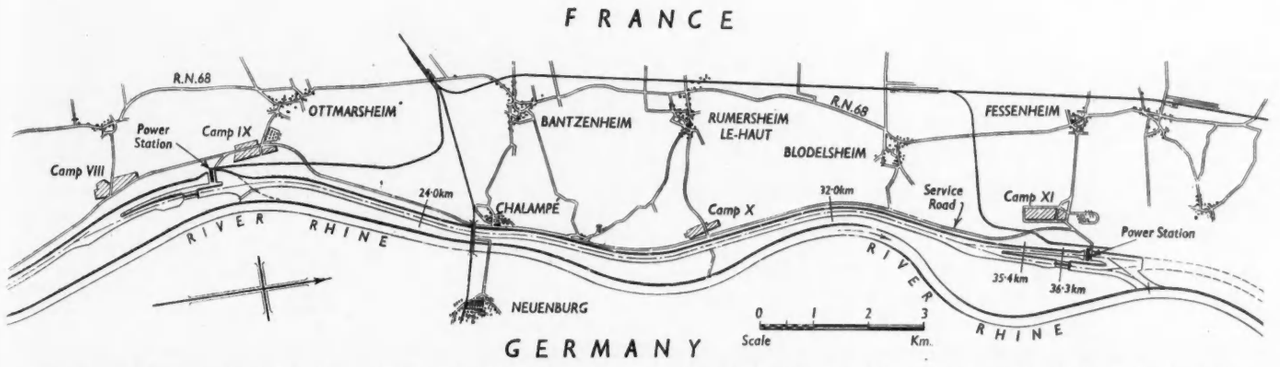
| Stage No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Station | Kembs | Ottmars-heim | Fessen-heim | Vogel-grün | Marckols-heim | Sund-house (Rhinau) | Gerst-heim | Stras-bourg |
| Construction | 1928–32 | 1948–52 | 1953–57 | 1957–60† | — | — | — | — |
| Position along canal, kilometres | 6·296 | 20·523 | 36·980 | 50·580 | 66·380 | 81·080 | 95·780 | 113·880 |
| Length, kilometres | 6·296 | 14·227 | 16·457 | 13·600 | 15·800 | 14·700 | 14·700 | 18·100 |
| Normal impounding level, metres | 243·9 | 230·00 | 214·50 | 198·80 | 186·25 | 173·75 | 161·50 | 149·25 |
| Gross head (above river outfall) | 16·6 | 16·25 | 16·50 | 13·40 | 13·40 | 13·85 | 13·05 | 12·60 |
| Minimum head for maximum flow in canal, metres | — | 14·70 | 15·20 | 11·80 | 11·80 | 11·55 | 11·60 | 12·25 |
| Installed capacity, megawatts | 6×28 | 4×35 | 4×40 | 4×35 | — | — | — | — |
| Mean annual generation, million kilowatt-hours | — | 906 | 936 | 720 | 720 | 705 | 708 | 747 |

* Figures for stations 5 to 8 are for the scheme as originally planned.
† Estimated date of completion.



**Fessenheim power station from upstream side, showing spillways in the centre, and at water level on either side, openings for the removal of ice**

* A description of Kembs will be found in THE ENGINEER, August 26, 1932, and of the Ottmarsheim stage, in our issues of June 6 and 13, 1952.




**The Fessenheim stage, showing the power stations and locks of Fessenheim and Ottmarsheim (left). The Franco-German frontier is formed by the Rhine**

canal is considerable. Besides the circumvention of the Istein bar by the Kembs section, which really makes navigation to Basle possible, there is a large saving of fuel as well as of time. Thus, a 1000-ton self-propelled barge is stated to require 860 h.p. on the upstream river voyage, but only 220 h.p. in the canal, and the gain on the return trip is given as half an hour for each 15km reach, including passage through the locks.

### Fessenheim

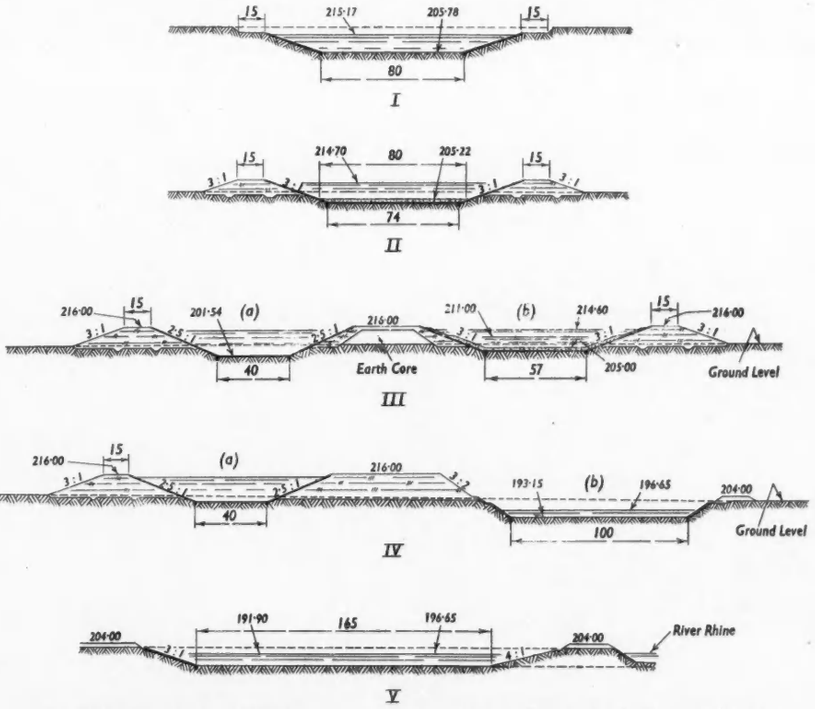
The Fessenheim section of the canal (above) commences at km 21 of the scheme, about 600m below Ottmarsheim power station, where the tail-race formerly flowed back into the Rhine. From this point, the canal continues for 12,845m at its normal section, then for 600m at an increased section. After this comes the 600m long turning basin from which branch on the westerly side the power canal, which continues for 1550m to the power station, and on the eastern side, towards the river, the parallel ship canal which leads to the locks about 1000m further downstream. Below the power station, the two branches unite again at km 37, and are returned to the Rhine at km 37·855 (river km 212·100).

*Canal.*—The height of the ground above sea level drops from about 222m at Ottmarsheim to 204m at the Fessenheim power station, whereas the banks of the canal are at 216m throughout, except for the first kilometre at Ottmarsheim. The depth of the water table below ground level varies seasonally, e.g. at km 24 it is between 5m and 8m, and at km 32 between 4m and 7m, the position at other points being approximately *pro rata*.

Typical canal sections are shown herewith. The flat bottom has a clear width of 80m, with banks sloping at an angle of 1 in 3. The water is 9·4m deep, making the width at the surface 136·4m. The flat top of the embankments is 15m wide, and the outer slope, where the canal is above ground level, is also 1 in 3.

The longitudinal slope of the canal is about 7cm per kilometre. The embankments are formed by the excavated alluvial subsoil, and were not specially compacted other than by the rolling action of the heavy plant bringing new material. Reinforced concrete slabs 7m by 3m by 9cm thick are used to line all the banks, the slabs being provided with bituminous joints. Below canal km 29, the bottom is lined with concrete which was put down in 7m wide strips, and subsequently covered with a 1m layer of ballast in order to enable ships to anchor. For 2½km upstream of this point, the bottom is formed of two layers of compacted earthfill with a layer of bentonite in between, the whole being covered by 60cm of ballast.

Upstream of this section there is a 2½km stretch consisting of two compacted layers without bentonite and a 40cm covering of ballast. The final 2km to Ottmarsheim have merely a single compacted layer on the bottom of the canal.




(I) Typical cross section of canal, km 24·0.
(II) Typical cross section of canal km 32·0.
(III) At km 35·4 (*a*) power canal, (*b*) ship canal.
(IV) At km 36·3 (*a*) power canal, (*b*) ship canal showing widened section downstream of locks.
(V) Tail-race canal leading to River Rhine.

**Typical canal sections—Fessenheim**

At approximately km 35, as has been mentioned, the canal divides into the power canal and the ship canal. The former is 13m deep and of trapezoidal section, with a 40m wide flat bottom and sides sloping at 1 in 2·5.

The ship canal above the locks is 57m wide at the bottom, with sides sloping at 1 in 3 ; below it widens to 100m at the bottom with banks at slopes of 2 in 3, and a depth of water of 3·5m. Finally, where the two channels reunite downstream of the power station, the channel is 165m wide at the bottom.

*Locks.*—The installation comprises a double lock, each chamber having a useful length of 185m. The large chamber is 23m wide and can be filled and emptied at the rate of 1·5m per minute ; the small chamber is 12m wide, with a rate of 3m per minute. Total transit time for the large lock is stated to be twenty minutes, and for the smaller one, ten minutes. For a lift of 10m, these times are claimed to constitute a European record.

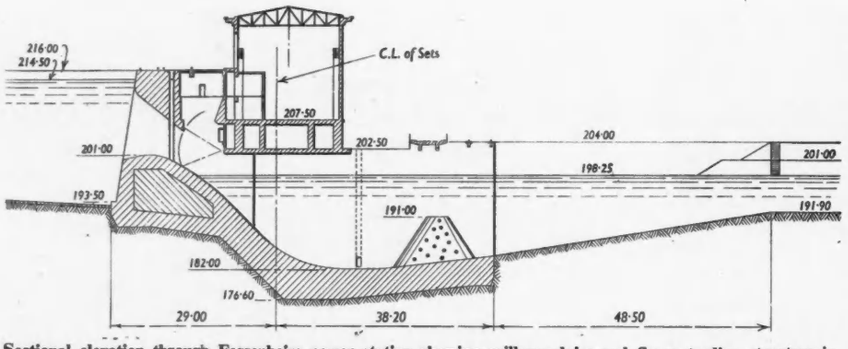
Except for their difference in width, the construction of the two locks follows along similar lines. On either side below invert level, there are two culverts each of approximately 10 square metres sectional area, for the flooding and draining of the lock. Each culvert communicates with a central conduit under the lock, from which branch conduits distribute the water. The main culverts extend from intake to outlet over about 250m ; during severe flood conditions they can be used as additional spillways with a maximum total flow of 230 cubic metres per second.

The upstream lock gates are mitre gates, while lifting gates are used at the downstream end. The lifting gate for the 23m chamber weighs 350 tons and has a counterweight of 370 tons. All gates and valves are electrically operated from a central control room at the downstream end of the lock. Operation is facilitated by the floating bollards, which render it unnecessary to re-tie the ships' mooring lines during lifting or lowering.

*Power Station.*—A view of the power station from upstream is shown on page 322, and a cross section overleaf. When fully equipped later this year, the station will have four Kaplan sets, each developing 60,000 h.p. The generators are designed to give 45MVA at 10·3kV, 50 c/s, at 0·9 power factor. Operating at 88·23 r.p.m., they are designed for a head of 15·05m to 15·85m. Maximum flow capacity is 290 cubic metres per second per set, or 1160 cubic metres per second, for the whole station.

Four spillways equipped with sector gates are situated in the centre of the station, each measuring 4·10m by 6m in area. Each spillway is automatically synchronised with one of the sets, so as to keep the canal water tranquil for navigation. The 14m deep stilling basin is fitted with energy dissipating structures, consisting of concrete pyramids about 8m in height with horizontal steel pipes extending between them. These pipes are 30cm in diameter and are filled with concrete.

Electrical equipment includes four unit transformers of the outdoor kind. They are designed for 45MVA, three-phase, and a primary voltage of 10·3kV. Secondary voltage is 150kV (delta) or 225kV (star). Main busbars are of aluminium channels and are housed in cylindrical safety covers. The power station equipment includes two 150-ton–20-ton overhead cranes.




**Sectional elevation through Fessenheim power station showing spillway sluice and flow-retarding structure in tail-race**

The station's annual generating capacity, based on the 1900-51 records, averages 946 million kWh, compared with 1114 million kWh in the wettest year (1910), and 642 million kWh in the driest (1921).

The power house (see title illustration) has a length of 157·70m, including the transformer annexe ; a total width of 67·20m, and an overall height of 52m from the foundation at 176·60m (above sea level) to the roof at 228·60m

To assist dewatering the power station excavation, a watertight "trough" was formed by injecting bentonite into the subsoil which here extends to a depth of over 200m. The walls of the trough were 10m thick, and the bottom, which reaches to a depth of 45m, is 8m thick. Of the 40,000 tons of injected material, 35,000 tons were bentonite and the remainder cement and chemicals.†

† See THE ENGINEER, June 17, 1955, page 851.

Table II shows the quantities involved in the construction of the Fessenheim stage.

TABLE II—*Fessenheim : Constructional Quantities*

| | Canals | Locks | Power station | Total |
|---|---|---|---|---|
| Earth moving, cubic metres ... ... ... ... ... ... | 20,100,000 | 490,000 | 430,000 | 21,020,000 |
| Concrete construction, cubic metres ... ... ... ... ... | 272,000 | 256,000 | 172,000 | 700,000 |
| Reinforcing steel, tons ... ... ... ... ... ... ... | 2,300 | 2,500 | 3,200 | 8,000 |

TABLE III—*Vogelgrün : Constructional Quantities*

| | Canals | Locks | Power station | Total |
|---|---|---|---|---|
| Earth moving, cubic metres ... ... ... ... ... ... | 15,200,000 | 560,000 | 640,000 | 16,400,000 |
| Concrete construction, cubic metres ... ... ... ... ... | 215,000 | 185,000 | 172,000 | 572,000 |
| Reinforcing steel, tons ... ... ... ... ... ... ... | 1,200 | 1,500 | 3,800 | 6,500 |

VOGELGRUN

*Canal.*—The reach between Fessenheim and Vogelgrün (illustrated below) extends from canal km 37·8 to canal km 51·835 (river km 226·550) where the water is restored to the Rhine. From the diversion from the end of the present stage (about 1km below Fessenheim power station), the Vogelgrün section will have a length of 9770m at the ordinary cross section, followed by 600m of increased section, and another 600m for the turning basin. After this the canal divides, one branch continuing to the power station, the other to the locks. The 1450m long power canal is of the same section as the one at Fessenheim, 40m broad at the bottom and with sides sloping 1 in 2·5. There is, of course, no layer of ballast to provide an anchorage. The approach to the locks is 74m wide at the bottom, and its sides have slopes of 1 in 3.

*Locks.*—There will be two locks, each having a useful length of 185m ; one will be 23m wide, the other 12m. The lift will be from between 185·40m and 198·80m sea level, a total of 13·40m (before completion of the Marckolsheim section which is, however, in abeyance—for reasons given below). Route Nationale No. 415 crosses at the lower lock gates. This road will also require a bridge over the power canal.

The main portion of the reach is 80m wide at the bottom, with sides sloping at an angle of 1 in 3 ; the depth is 9·40m, and the width at the surface is 136·40m. The width of the turning basin is 200m at a depth of 3m below the minimum navigable water level.

The tail-race is 1500m long and between 123m and 165m wide at the bottom. The downstream entrance channel to the locks has a length of 600m, and is 100m wide at the bottom.

*Power Station.*—In its general layout, Vogelgrün power station (shown overleaf) will resemble Fessenheim, with four Kaplan sets, each of 48,000 h.p. generating 39MVA at 10·3kV, 50 c/s, three-phase, at 0·9 power factor. Turbine speed will be 83·3 r.p.m. The maximum design flow is 290 cubic metres per second per set, the gross head, 13·4m. As in the case of Fessenheim, the turbines will be automatically synchronised, each with its own spillway, so as to maintain tranquillity in the canal. The spillways will be in the centre of the station, and will be controlled with sector gates.

Each set will have its own unit transformer of 39MVA, three-phase, and a ratio of 10·3kV primary voltage to 150kV secondary voltage (delta connection) or 225kV (star connection).

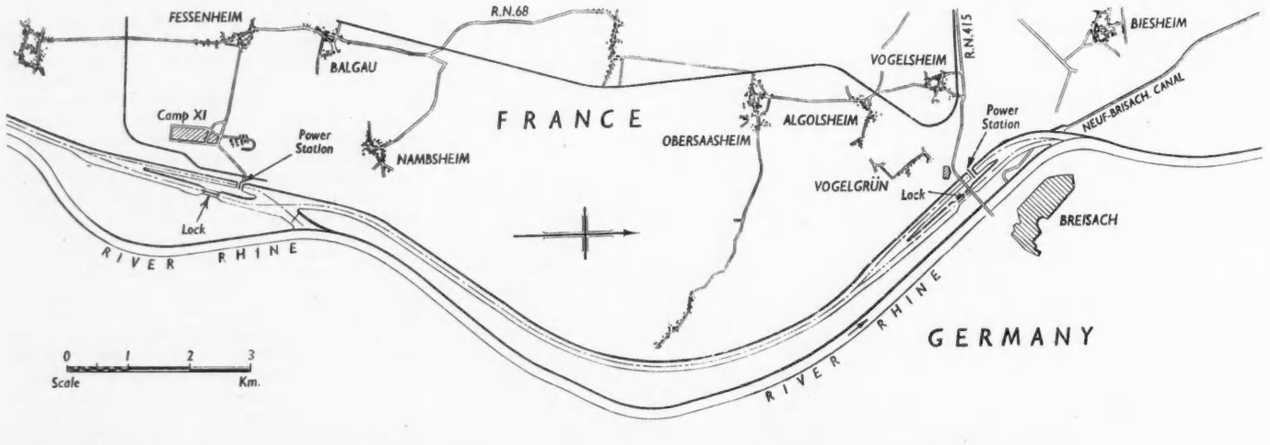
Output in the mean year will amount to 813·8 million kWh. The wettest recorded year (1910) would have yielded 926 million kWh, the driest (1921), 583·6 million kWh.

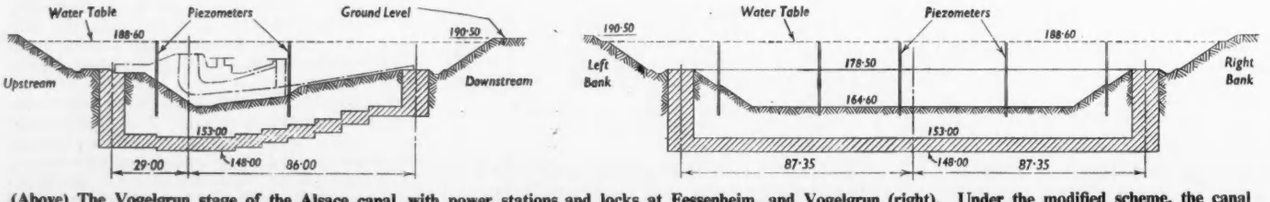
The overall dimensions of the power house, including transformer annexe, will be 158·50m long, 65·20m wide, and 47·15m high between the foundation sea level of 164·60m and the roof at 211·75m.

Work has been in progress since last summer, and work on the power station itself began recently. It is anticipated that the canal will be ready for filling by 1959, and that the work will be completed early in 1960.

Up to the present, 10,000 cubic metres of concrete have been placed, and 4,000,000 to 5,000,000 cubic metres of earth have been moved, out of a total of some 16,000,000 cubic metres.

Equipment includes three Bucyrus-Monighan




**(Above) The Vogelgrun stage of the Alsace canal, with power stations and locks at Fessenheim, and Vogelgrun (right). Under the modified scheme, the canal will terminate at Vogelgrun. (Below) Soil treatment ot Vogelgrun power station site. A watertight "trough" is formed with bentonite grout ; the grouted zone is shown shaded**

**Excavation for Vogelgrun power station. The Rhine and the town of Breisach are in the background**

"9W" walking draglines. These 460-ton machines are fitted with a 48m jib and a 12 cubic yard bucket, and have an hourly output of 500 to 600 cubic metres. There is also one "Marion" 8 cubic yard dragline, as well as "P and H," "Lima," "Koehring," and "Dominion" shovels, "Euclid," "Heil," and "Willeme" loaders and graders. Earth moved has so far averaged 180,000 cubic metres per month, with peaks of up to 195,000 cubic metres. The total labour force is about 4000 men.

Drainage of the site is being carried out in various ways. In the canal itself, a central drainage channel is being dug from which the water can be run off into the Rhine. Pumping will be necessary only at the power station pit and locks, and downstream of these points; eventually, the total pumping capacity will amount to about 5000 h.p.

In the case of the power house, a watertight "trough" will be formed, as at Fessenheim, by grouting with bentonite in the alluvial subsoil. The depth of the alluvial deposits varies along the canal, reaching up to 200m in places. The treated zone will measure 45m by 174·7m between "wall" centre lines, and will reach from the ground, at 190·5m sea level to 148m sea level, a depth of 42·5m. The "walls" will be 10m thick, and the bottom which will be stepped, will be 5m thick.

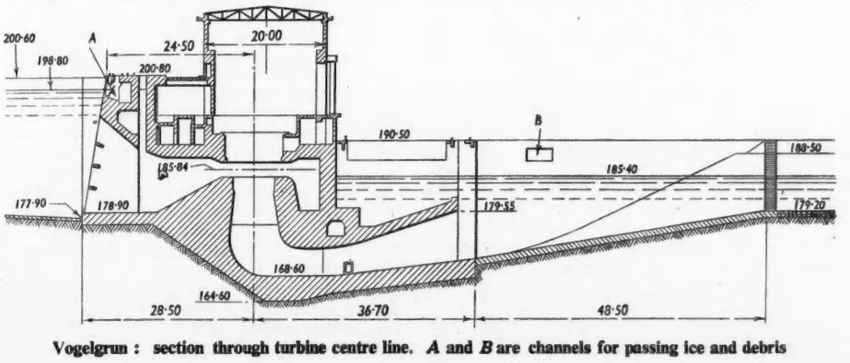
*Slab-Making Plant.*—Reinforced concrete slabs for lining the canal embankments are made in very large quantities by the vacuum concrete process. The slabs measure 7m by 3m and have a thickness of 9cm. About 100 to 120 slabs can be made daily. They can be handled after twenty-four hours, and are placed after one month's storage. The process was described in detail in our article on Ottmarsheim, referred to above.

*Aggregate Preparation.*—An aggregate washing and preparation plant has recently gone into operation at the Vogelgrün site. The 350 ton per day plant carries out separation into the following sizes: 60mm to 30mm, 30mm to 20mm, 20mm to 10mm, 10mm to 2·5mm, and sand. The sand is carried by the washing water and separated from the mud by flushing the washings over a large concreted area the shape of a sector. The larger particles of sand separate out near the centre, while the fines and mud settle near the edge where they are removed by a scraper.

The installation comprises an intake structure; preliminary screening; crushing, screening and washing tower; buffer storage dump; and distributing tower where loading of the lorries takes place. The whole plant has a total of about 1500m of belt conveyors. Special electrical interlocks permit the plant to be started and partially or completely shut down, without causing pile-ups or, in the case of emergency stops, causing unnecessary hold-ups in parts of the plant which are not affected.

### Modification of Scheme

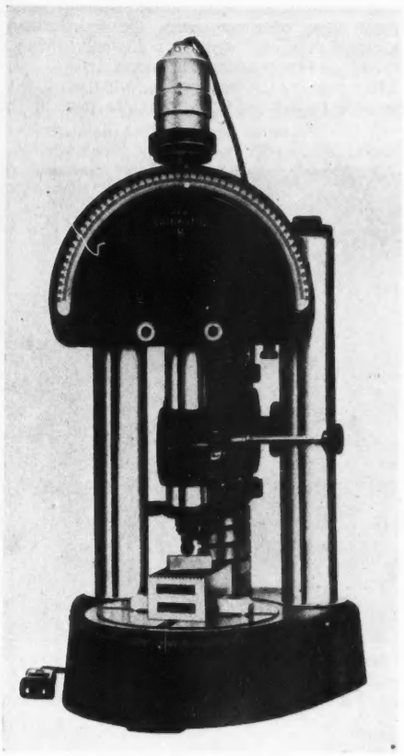
German opposition to the canal based itself on the argument that too much water was being withdrawn from the Rhine, rendering navigation impossible on the German side, and endangering agriculture by causing an excessive dropping of the water table. As the result of negotiations it was decided last autumn to modify the scheme and to build the remaining four power stations (Marckolsheim, Sundhouse, Gerstheim, and Strasbourg) on side canals, with barrages and locks on the river itself.




**Vogelgrun: section through turbine centre line. *A* and *B* are channels for passing ice and debris**

## High-Sensitivity Indicator

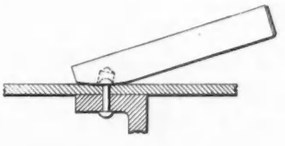
We have received particulars of the "Optikator" indicator made by VEB Feinmesszeugfabrik Suhl, Suhl (Thuringia), German Democratic Republic. In this instrument, the movement of the measuring plunger is first mechanically magnified, by a flexure-pivoted link, which tensions a torsional filament carrying a mirror. The image of a cross-wire is projected by the mirror on to the 180 deg. scale. Two versions are made, giving readings down to 0·0001 (0·0002)mm per scale division, corresponding to magnifications of 10,000 (5000) times. The range in the two cases is ±0·012 (0·025)mm. It is stated that tolerance limits can be set by means of the optical arrangement, so that the indicator spot flashes red or green as the case may be. Our illustration shows the indicator mounted on a stand which gives an 80mm clearance between measuring centre and columns, and admits test pieces up to 175mm high. The indicator is handled in this country by Mortimer Engineering Company, 210 Acton Lane, London, N.W.10.



**High-sensitivity indicator**

## A Cutting Chisel for Rivet Heads

In repair work, demolition and alterations of steel constructions, it is common practice to chisel off heads of the rivets and tscrews. The rivet heads may bounce off into the air and cause injuries. As it is seldom possible to arrange that the heads fly off in one direction



only, it may, we are advised, be found advantageous to tackle the problem by the simple and effective method shown in the illustration.

The head of the rivet, after it has been chiselled off, will be left lying in the hole drilled in the chisel. As illustrated here, the chisel is of tool steel and the hole is drilled at such an angle as to give the maximum cutting effect. The diameter of the hole is somewhat larger than the heads of the rivets to be removed.

The chisel is hardened after being shaped and, it is claimed, can easily be sharpened.*

* "Huggmejsel for Nitskallar," *Maskinjournalen* (Sweden), Vol. 7, No. 1, 1956, page 8.

## Railway Bridge at Essen Station

In the course of rebuilding and extending the main station at Essen, which suffered heavy damage during the war, it became necessary to add one more track at the point where the railway lines cross Kettwiger Strasse. The other lines are carried across the road on four-span plate girder bridges with three intermediate trestle supports. The roadway passes under three of these spans, the fourth being occupied by a row of shops until such time as a widening of the road becomes necessary.

In designing the new bridge, attention had to be paid to the fact that tramlines pass in the centre of the road ; because of right and left-hand points where the tram emerges from under the railway, the space available for the supports for the extra track was limited. The new track lies at a slight angle to the remainder. Moreover, the possibility of subsidence had to be taken into account, as coalmining is at present being carried out only some 200m away.

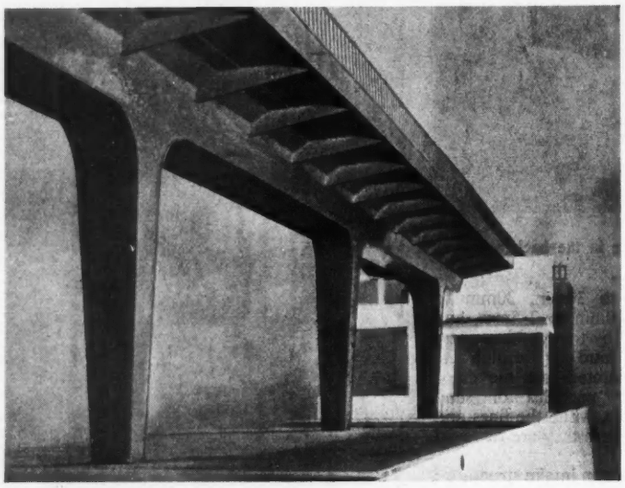


**Fig. 1—Model of Kettwiger Strasse railway bridge, Essen. Positioning of the columns was restricted, and the bridge is designed to withstand mining subsidence.**

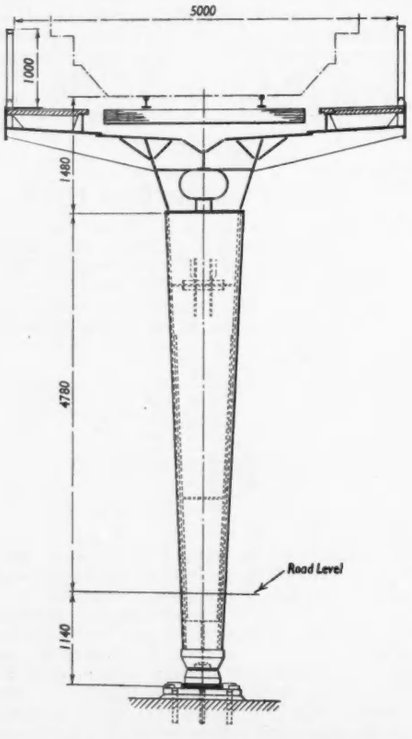



**Fig. 2—Central column of bridge. Each column has a ball joint at its base. The joints are held in position relative to the central column, and can slide over the substructure if "draw" occurs**

To cover these various considerations an elegant solution was found. As shown in our illustrations, the bridge takes the form of a continuous beam supported at five points, the spans being 14·95m, 14·54m, 14·95m and 17·10m. Both ends rest on rollers ; the middle supports are single columns of tapering rectangular section which are rigidly connected with the bridge itself. All three columns rest on spherical joints. Only the seating supporting the centre joint is fixed to the foundations ; the other two rest on rollers but are joined to the central block by tension and compression members placed below road level. In this way the bridge is held in position by the central support, but can move at all the other supports. This arrangement gives structural immunity from "draw." Vertical movements of the foundations can be corrected by jacking up the supports hydraulically and making adjustments by means of shims.

That such elaborate precautions against the effects of subsidence are necessary is shown by the fact that, over the space of decades, horizontal extensions of ½m and slightly lesser compressions have been recorded over distances of 100m.

The bridge is designed to withstand torsional forces and longitudinal impact forces up to 100 tons. It is laid out for the heaviest goods trains (schedule S1950). Because of the wholly welded construction the weight of steelwork without railings and track, but including the support columns, amounts to only 126 tonnes (about 2 tonnes per metre). The appearance of the design may be gathered from Fig. 1. The material used was St. 37 steel (mild steel) in open hearth quality, in thicknesses up to 30mm.

Compared with the design for the main bridge which dates from 1932, savings will amount to 22 per cent on the foundations, 15 per cent on the steelwork and 62 per cent on steel castings. The completed structure will be protected by two coats of red lead paint followed by two coats of synthetic resin paint.

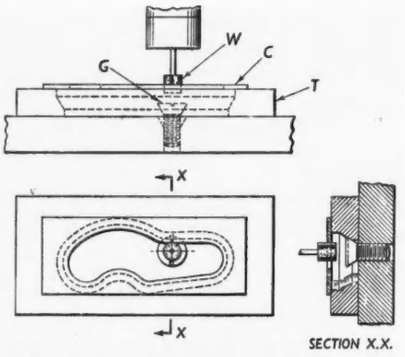
The design was developed in collaboration between the bridge department of Bundesbahndirektion Essen (Dipl.-Ing. Erich Hofmann) and the firm Johannes Dörnen Stahlbauwerk, Dortmund-Derne (Professor Dörnen).

## Grinding Internal Contours

Certain difficulties invariably arise when internal contours have to be ground with great accuracy, and these are, of course, even greater with tempered pieces.

A workshop had the problem of grinding an internal contour on a series of cams, tempered and ground smoothly on both faces.

The problem was solved in the following manner* : the cam *C* was fixed to a template *T* the exact shape of the contour to be ground. The template was fastened to the grinding machine so that it could be moved by hand, its movements restricted, however, by a guiding bolt *G* fastened to the table of the grinding machine. In order to make the contour of the workpiece exactly like the template, the guiding bolt and the grinding wheel *W* had to be concentric and of the same diameter. These requirements were difficult to fulfil, as the diameter of the grinding wheel is perceptibly reduced during the grinding of larger surfaces. On the figure, cross-section *x*—*x*, it is shown how this difficulty was overcome.

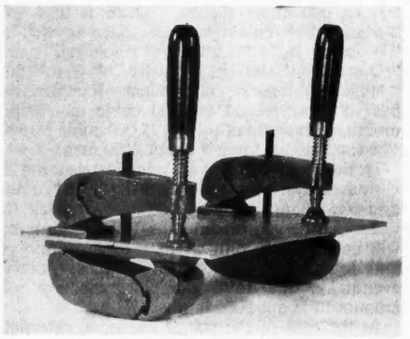



A screw with a countersunk head was used as the guiding bolt and the template was chamfered at an angle corresponding to the angle of the screw head. When the screw was loosened a few turns, the template could be moved slightly and thus the reduction of diameter of the grinding wheel was compensated.

* "Slipning av Innvandiga Konturer," in "Verkstaderna" (Sweden), Vol. 52, No. 5, May, 1956, page 145. Quoted in *E.P.A. Digest* 1516 (r), distributed in the U.K., free on demand, by the D.S.I.R., (T.I.D.U.) Cunard Building, 15, Regent Street, London, S.W.1.

## Welding Clamp

In our accompanying illustration we show a welding clamp manufactured by Hans Joachim De Vogt Vorrichtungsbau (22a), Solingen-Ohligs, Lennestrasse 8, German Federal Republic. It shows the "Nahtgreif" clamp for the butt welding of sheets and plate. The material, it is stated, is held firmly at the correct level and distance, without possibility of gaps opening or of overlapping. The clamps comprise an upper and a lower part connected by a renewable tension strip. At the same time, the thickness of the strip is chosen equal to the required gap between the two plates, so that it serves at the same time as a spacing gauge. A flat jaw extends over the whole of the lower portion and on it rest the lower surfaces of both plates, which are thus clamped level on that face. The other sides can differ in level by up to 25mm, in the same way, flanges standing up to 25mm proud of the plate can be bridged. For use on longitudinal seams of cylinders, the flat jaw is removed, thus giving the lower part point support at its ends against the inner wall of the cylinder. By means of additional equipment, it is possible to set up plates at 90 deg. to each other.



**Two clamps set up to illustrate the butt welding of sheet. The strips connecting the two halves of each clamp also act as spacers**

### Rational Utilisation of Coal

At a recent meeting arranged by the E.C.S.C. High Authority in Luxembourg, the principal coal producers of the Community decided to co-ordinate their plans for fuel economy. Each is to summarise the progress so far made by itself in investigations into the rational utilisation of coal, so that an accurate comparison can be made ; a further meeting for this purpose is scheduled for September. In view of the efforts already made towards the economy of fuel by certain large groups of consumers, the producers decided to concentrate on two groups, i.e. "miscellaneous industries" and "domestic consumption."

# U.S. Army Package Power Reactor in Virginia

BY OUR AMERICAN EDITOR

No. II—(*Concluded from page* 285, *August* 23)

*The 1925kW "Army Package Power Reactor" (APPR) recently went into operation at Fort Belvoir, Virginia, and is the first nuclear generating station of the U.S. Army. It is the first prototype of a family of nuclear power plants under development by the U.S. Atomic Energy Commission and the U.S. Department of Defence for use by the three military services. The concept envisages that the components will be transportable by air and capable of erection at a remote field site in a six-month construction period. The reactor is of the pressurised water, light water moderated design and uses fully enriched uranium fuel.*

### Electric Generating Plant

THE electrical power is generated by a 2500kW, 4160V, three-phase, 60 c/s turbo-generator, rotating at 1200 r.p.m. An outdoor substation is provided, however, in order to supply power for station services at 460V, 208V, and 110V. For the station services two 300kVA transformers are installed, one being used as a reserve in the event of failure of the normal transformer. An emergency 125V d.c. battery system is provided for use in the event of complete power failure.

### Safety Provisions

Even with the inherently stable characteristics of the Army Package Power Reactor, the site of the installation, only 18 miles from Washington, D.C., required that special emphasis be given to the containment of radioactivity. A vapour container had to be designed that would be capable of withstanding the maximum credible accident, even though such an accident is highly improbable. Before the overall APPR design could be approved, the reactor design was reviewed by the advisory committee on reactor safeguards. The design was accepted by the committee without modification. Fortunately, the APPR is a highly stable reactor ; it has a strong negative temperature coefficient and a resulting high degree of safety. Operating at full power, the pressurised-water reactor has a temperature coefficient of at least $-2\times10^{-4}$ per deg. Fah. No additional control mechanism is needed to override any rapid transients or power excursions. However, because the reactor operates at high temperatures and high pressures, ample safeguards were provided.

The primary shielding for the reactor consists of eight layers of iron, each 2in thick, in a tank of water surrounding the pressure vessel enclosing the reactor. The water interspersed with iron layers provides shielding for the neutrons ; the iron attenuates gamma leakage from the reactor to a level equal to that from other primary system components. The neutron attenuation provided by the water is more than adequate for radiological safety purposes. The water in the tank above the reactor shields the personnel during the replacement of spent fuel elements. The design is lighter and easier to transport than the alternative concrete shield. Secondary shielding is provided by the concrete which forms part of the vapour container described below.

Containment in the APPR is provided by a dome-shaped vapour container 36ft in diameter and 64ft in height, which is used to house the equipment in the primary coolant circuit. The vapour container was fabricated by the Bethlehem Steel Company and consists of a central cylindrical section with top and bottom hemispherical sections. It is hermetically sealed, and all seams were radiographed. The steel shell is lined with 2ft of concrete. An additional 3ft of concrete surrounds the container from ground level to the height of the control room roof. This concrete provides a biological or secondary shielding as an extra measure of protection in the immediate area. Should a nuclear incident occur, the hermetically sealed vapour container will confine any radioactive particles and gases and prevent their release to the atmosphere. The upright cylinder and spherical end design was selected from several possible vapour container shapes as best suited to contain the primary coolant circuit. It permits the economical use of space and allows the primary system equipment to be situated near both the secondary system equipment and control facilities and the demineralising and decontaminating areas. It thus keeps piping, cables and conduits connecting the various system components to minimum lengths.

Stability was provided by placing the lower hemisphere below ground level. This arrangement also provided extra shielding for the reactor yet permitted the rest of the vessel to be constructed in the open. The vapour container has enough net volumetric capacity to hold safely all pressurised vapour and liquid fluids which would be released by a simultaneous rupture of both the primary and the secondary systems. The cylindrical outer steel shell of the vessel is $\frac{7}{8}$in thick, and the hemispherical heads are $\frac{1}{2}$in thick.

As added reinforcement to the lower head a $\frac{7}{8}$in plate, 4ft in depth, is situated just below the bend line. The manhole covers are made of 2$\frac{1}{2}$in steel plate. The welded seams were 100 per cent radiographed and plate thicknesses greater than 1$\frac{1}{4}$in were stress-relieved after welding. The vapour container shell has two manholes ; both open inward to ensure tightness under internal pressure. The top manhole has a net internal diameter of 6ft 7in and was used to install equipment initially, as in Fig. 1 (*ante*). This manhole has a gasketed and bolted joint and is seal welded. The lower horizontal manhole has a door at each end, is 9ft long, and has a net internal diameter of 4ft 6in. It penetrates the concrete secondary shield, and personnel use it for access to the vapour container. This manhole also has a gasketed and bolted joint. The lower manhole filled with water, together with the steel in the manhole covers, provides a biological shield equivalent to 5ft of concrete.

The three principal components housed within the vapour container—the reactor, the steam generator and the pressuriser—are anchored to the concrete in the base of the container to resist thrust that might result should the bottom of the vessel rupture and tend to propel the vessel upward as a missile. The tie-down bolts anchor the steam generator, pressuriser and shield tank (through which the reactor thrust is transmitted) to the concrete floor of the vapour container. The bolts are anchored in the concrete floor with nuts and plate washers designed with strength at least equal to that of the bolts. The reinforced concrete floor over the anchor washers resists the upward pull of the bolts through a system of local beams designed for a maximum moment of 4,300,000 lb ft and a maximum shear of 400,000 lb.

The lower head of the vessel is partially filled with concrete and provides a flat floor for mounting the primary system equipment. The concrete inner liner is covered with a 10 gauge steel liner with seal welded joints and seams. This inner liner protects the concrete liner from contamination and facilitates cleaning and decontamination.

Should a rupture occur, small metal objects may be propelled at high speeds from the point of rupture. Since these missiles could perforate a simple steel shell containment vessel and thus release contaminated particles and gases to the surrounding areas, the vapour container is lined with 2ft of concrete except where manholes, pipes and conduits penetrate the shell. To provide impact resistance to missiles at the manholes, the latter are anchored into the concrete liner with diagonal reinforcing rods. This is in addition to the mass effect of the manholes themselves and the heavy circumferential welds to the vessel shell and reinforcement pads.

After the outer shell was completed, but before the installation of any concrete or equipment, all piping penetrations were capped and conduit penetrations were temporarily plugged. Then, with the spent fuel chute plug in place, testing of the vessel was conducted in two stages : (1). A hydrostatic proof test, using water at 75 lb per square inch gauge pressure at the top of the vessel. (2). A helium leak test using a modified mass spectrometer leak detector.

The APPR circuitry includes three parallel circular plate chambers, which will cause a scram if the neutron flux exceeds 150 per cent of the flux at 10MW reactor power. In addition, the signal from a compensated ionisation chamber is fed to the period circuit, which will cause a scram if the reactor period becomes less than three seconds. The parallel circular plate ionisation chamber, a thimble adjacent to the reactor vessel, is designed for high-speed response to changes in neutron flux levels and for a reliable measurement of flux over a large range, particularly in the presence of intense gamma radiation. The safety circuitry is extremely fast : the control rods will start to drop about 60 milliseconds after the scram or shut-down signal is generated; and 250 milliseconds after the drop starts 2 per cent of negative reactivity will have been introduced.

In addition to the nuclear safety circuits, there are certain limits in the sensing elements of the primary loop which can initiate a scram. The design flow rate in the primary loop is 4000 gallons per minute ; if the flow drops 40 per cent while the reactor is operating, a scram is automatically initiated. The control rods cannot be raised without first starting the primary coolant pump, and during routine operation the reactor cannot be brought critical until at least 60 per cent of the design coolant flow rate is achieved. The design pressure of the system is 1200 lb per square inch, and a scram will be initiated if this pressure reaches 1450 lb per square inch. Furthermore, if the reactor outlet temperatures goes 20 deg. above the design point of 450 deg. Fah., there will be a scram. A deliberate back leakage of water is allowed through the standby pump in the primary loop so that the temperature of the water in this dead leg is essentially the same as that in the flowing loop. Should the temperature in the dead leg drop more than 10 deg. Fah. below that in the loop, the stand-by pump cannot be started without first shutting down the reactor.

### Testing Procedure

The demand for cleanliness required the careful inspection of all primary system components. The components were cleaned during manufacture and their cleanliness was maintained during shipment and installation. After the assembly of the primary system, its pressure vessels and circulating pumps were checked for leakage by the helium-mass spectrometer method and by hydrostatic test. Blank flanges were used to seal the openings for the control rod drives. When the system was clean it was evacuated and filled with water of operational quality with a dummy reactor core in place. Then the flanges installed for vacuum and pressure checking were removed and the rod drives and seals installed. The circulating pumps were started and the primary loop was brought to operating temperature by external heat.

When the system reached operating temperature and pressure, all operating and emergency controls and instruments were checked for performance. Additional checks were made at the seals and at any other points where joints could

# U.S. ARMY PACKAGE POWER REACTOR, FORT BELVOIR, VIRGINIA

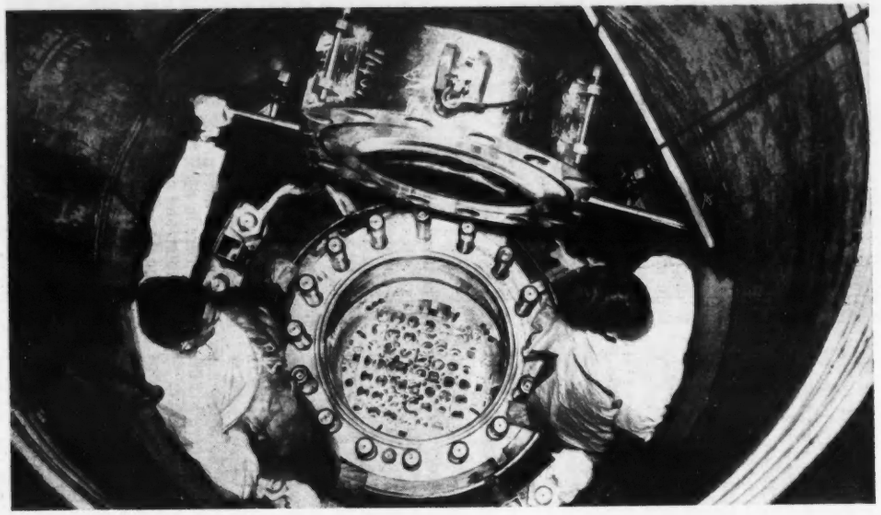


Fig. 4—Overhead view of completely installed core structure of U.S. Army Package Power Reactor

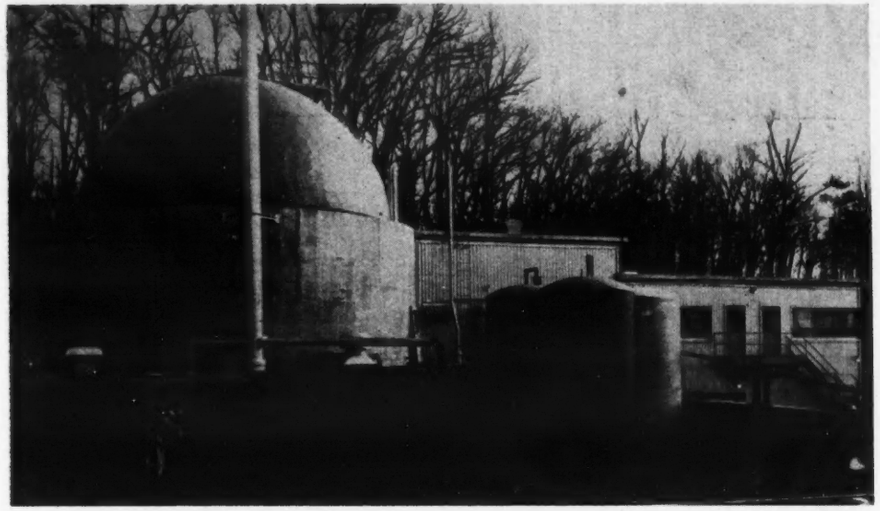


Fig. 5—Completed package power reactor installation at Fort Belvoir, with vapour containment vessel at left

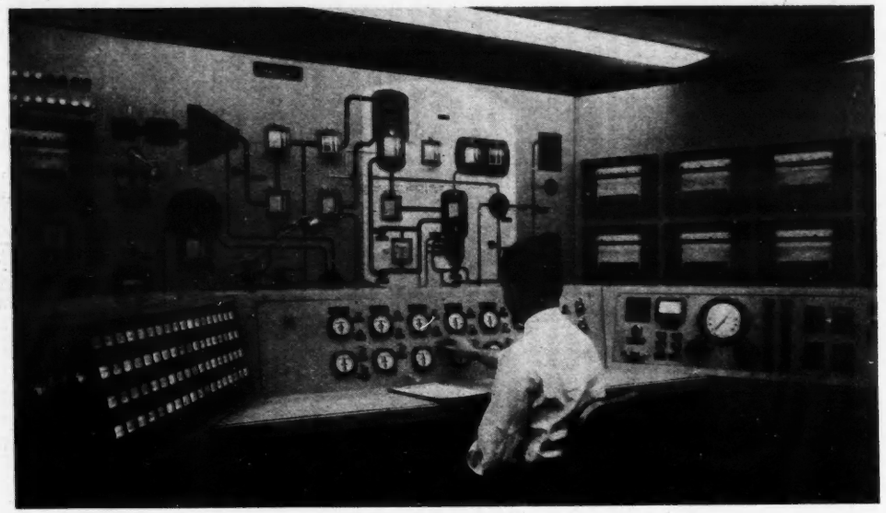


Fig. 6—Control room of U.S. Army Package Power Reactor with indicating and recording instruments

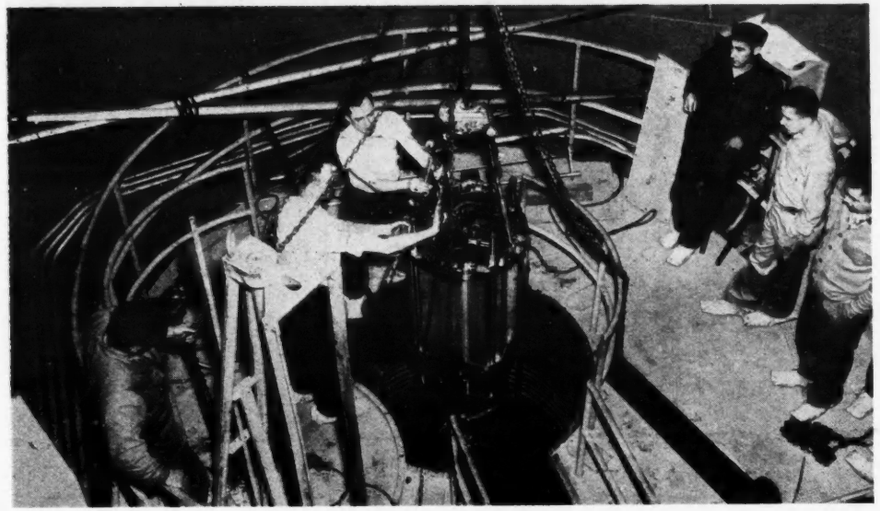


Fig. 7—Installation of nuclear core structure in primary shield tank of U.S. Army Package Power Reactor

have been disturbed by the hydraulic test. The system was operated for several days to demonstrate its integrity and then was returned to room temperature and atmospheric pressure. The shield was filled with water and the top cap removed from the pressure vessel. The circuits of all nuclear instruments were checked by simulating a chamber signal at a point as close to the chamber as possible. This method was used to check the nuclear scrams and interlocks ; it also afforded a rough check on the flux-servo operation. After the operational checks were completed, the unloading procedure was initiated, using the dummy fuel elements and under-water handling tools. The operation of the fuel-discharge chute was also checked.

A complete check of the system showed it to be operating satisfactorily ; the control rods and fuel elements were then added individually and the sub-critical multiplication was measured after each element was in place. Counters for this test were mounted temporarily next to the reactor core within the pressure vessel. As additional fuel was added after initial criticality, the position of the rods was noted to obtain a calibration of rod worth in terms of fuel addition. The rods were also calibrated against reactor period and additional zero-power experiments were performed.

Following zero-power testing, the cap was placed on the pressure vessel, the pressure in the primary system was raised to 1200 lb per square inch, and the primary pumps were started. With the reactor held critical by the flux-servo control, the system was heated to 450 deg. Fah. and the temperature coefficient of reactivity was measured as the temperature rose. The external heating was then stopped and the reactor power elevated to about 100kW, the vapour container having been sealed. By gradually increasing the electrical load on the turbo-generator, nuclear heat power was increased in steps to 10MW. Recently the plant was operated at designated power loads for 700 hours, with a maximum of forty hours of shut-down time being permitted. This was the final acceptance test performed on the APPR, during which a total of 1,181,000kWh of electric power was generated. The test involved shut-down time of only eight hours for adjustment and repair purposes.

### Fuel Element Fabrication

The fuel elements which have been produced initially for the APPR contain enough fuel to operate the reactor continuously for eighteen months at the full thermal power of 10MW. The present reactor core design is essentially unchanged from that originally proposed by the Oak Ridge National Laboratory. The fuel elements are arranged in a square array with the corners missing, and with seven of the forty-five positions occupied by the control rods. In establishing the design criteria, Oak Ridge selected stainless steel and uranium dioxide as the construction and fuel materials. Boron, in the form of boron carbide, was added as a burnable poison to increase the core life. The thickness of stainless steel cladding required was small because of its excellent corrosion resistance in pressurised water. The fuel unit proper is 27in long and is illustrated in Fig. 8. It was designed to contain eighteen 0·030in thick composite fuel plates, one above the other, but spaced 0·133in apart to permit cooling of the plate by flowing water. The sixteen inner fuel plates are 23in long ; they are designed to permit insertion and attachment of end fittings to facilitate positioning of the fuel elements in the reactor-grid plate. A pin is attached to the bottom adapter and a spring to the top adapter to assist in fixing the position of the fuel element in the reactor.

Normal 18-8 stainless steel was used as the wrought cladding, while special 18-8 stainless steel with 0·07 per cent maximum carbon content was used for the fuel core matrix. A dense uranium dioxide, in the size fraction of 44 to 88 microns, was selected as the fuel material, and boron carbide as the burnable poison to be mixed intimately with the fuel oxide. The fuel core of the composite plate was prepared by adding 28·62 grammes of $WO_2$, 0·188 grammes of $B_4C$ and 99·80 grammes of stainless steel powders. These elements were inserted in a small glass container, and a number of these containers were placed together in an oblique blender. After blending, the mixture was inserted in a die and pressed under 33 tons per square inch to form the fuel core for the composite plate. When a number of cores had been accumulated, a batch was sintered in a hydrogen atmosphere at 2150 deg. Fah. Each core was again placed in the die and coined to final size. Once formed, the coined fuel cores were inserted in blanked frame plates ; covers were attached to each side of the frame and the plates were fabricated into composite fuel plates. They were preheated in a hydrogen muffle at 2100 deg. Fah. and rolled to a 91 per cent reduction in thickness. During hot rolling, the stainless cladding was metallurgically bonded to the stainless steel core material. The clad fuel was then reduced to its final dimensions—22in long, 2½in wide and 0·020in thick—by cold rolling. After locating the fuel core by fluoroscopy, the plate was marked, sheared, and machined to a width of 2·776in, thus allowing for an inactive steel protective edge along the length of the core.

Once annealed, the plates were assembled into a fuel array in a stainless steel fixture, designed to confine the fuel unit during assembling and brazing. After each plate was individually positioned, the assembled fuel unit was brazed in a protective hydrogen atmosphere, slowly and uniformly heated to 2066 deg. Fah., and then furnace-cooled. Following this, the unit was thoroughly

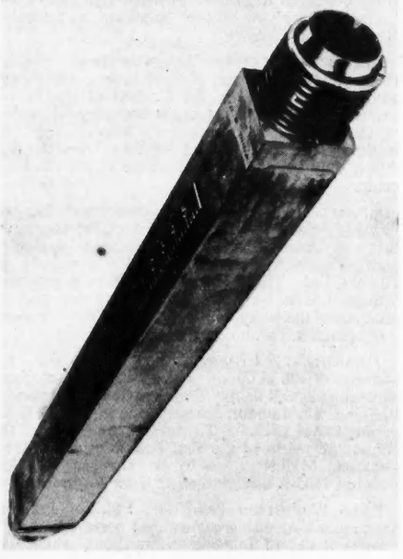


**Fig. 8—Fuel element assembly for the U.S. Army Package Power Reactor**

cleaned in hot water. The final steps in completing the fuel assembly were the " Heliarc " welding of the end adapters to the fuel unit, the machining of the end adapters, and the attachment of the pin and spring.

Several tests have been developed which indicate the functional qualities and reliability of the fuel elements. The stainless steel matrix of the fuel core may be embrittled during irradiation, but this effect can be reduced by using a $UO_2$ particle size of 44 to 88 microns, thus permitting a larger volume of stainless steel between the particles. This conclusion is supported by the test of a full-sized APPR element, which was irradiated in the lattice of the Materials Testing Reactor of the A.E.C. to an average burn-up of 25 per cent of the U-235 atoms. No visual damage was apparent and later microscopic examination revealed no significant effects. Another prototype element passed severe testing at the Westinghouse Atomic Power Division for more than 6000 hours under conditions simulating those in the Submarine Thermal Reactor. Here the corrosion of either the stainless steel or the brazed joints proved negligible. Hence, there is every indication that the stainless steel fuel element will meet the service requirements of irradiation and corrosion resistance expected in the APPR.

## American Pump-Turbine for Brazil

An order has been received by the S. Morgan Smith Company, of York, Pennsylvania, for a counter-clockwise, adjustable-blade, axial-flow reversible Smith-Kaplan pump-turbine from the Sao Paulo Light S.A.-Servicos de Electricidad of Brazil. The new unit will be installed in a vertical setting in the Traicao pumping plant near Sao Paulo. It will supplement two identical pump-turbine units supplied by the same company.

The Traicao pumping plant is situated on the Pinheiros Canal, and is one of a series of low-head pumping plants connecting the Tiete River with the Billings reservoir. This reservoir supplies water to the high-head Cubatao power station at the base of the coastal cliffs, near Santos. The unit measures 138in in diameter, is directly connected to a 6600 h.p. motor and will operate under a net head between 3m and 7m. It is guaranteed to pump 1765 cusecs under the 7m head at 150 r.p.m. When generating, it is guaranteed to produce 3450 h.p. under the same head. During times of low water in the Tiete River tributaries, water must be re-released from the Billings reservoir for irrigation and general municipal purposes ; under these conditions the pump-turbine operates in the reverse direction as a turbine and generates power. When the unit is not required as either a pump or a turbine, the water can be depressed from the runner passages with compressed air ; then the unit can be operated as a synchronous condenser to improve the power factor of the system.

## Joint American-European Atomic Energy Firm

A new corporation with United States and Belgian industrial ownership, named NDA Europe, has been formed in Brussels to assist in atomic energy developments in the six Euratom countries and their colonies, possessions and territories. The principal owners of NDA Europe are the Nuclear Development Corporation of America (NDA) of White Plains, New York, and the Societé Generale des Minerais, of Brussels. The Societé Belge pour l'Industrie Nucleaire (Belgonucleaire) is also a participant. The new firm will place the consulting, engineering, development and fabrication services of NDA in the U.S. at the disposal of European agencies, scientific bodies and industrial concerns. It will also perform manufacturing operations through European firms, making use of designs prepared jointly by NDA and European organisations. The projects to be undertaken will include the application of nuclear energy to power, propulsion and research. The registered office of the firm will be maintained in Brussels, at 31, rue du Marais.

## Automatic Control of Machine Tools by Magnetic Recording Tape

We learn that some automatic machines engaged on repetitive work in the United States aircraft industry are operating under the control of magnetic recording tape developed by the magnetic products division of the Minnesota Mining and Manufacturing Company of St. Paul, Minnesota, and Birmingham, England. The machines are tape-controlled spar- and skin-milling machines made by Giddings and Lewis Machine Tool Company, Fond du Lac, Wis.

In the Giddings and Lewis " Numericord " system key contour co-ordinates of the shape to be machined are taken from drawings and coded on a punched tape or punched cards. These co-ordinates are fed into an electronic computer which calculates the intermediate co-ordinates and records them on punched tape or cards. The latter are then treated by an " interpolator "—an electronic device which translates the intermittent incoming data into continuous information suitable for machine tool control when recorded on magnetic tape. It is stated that a roll of magnetic tape 1in wide, 7200ft long and 14in in diameter can control a machine tool for 1½ hours.

# Personal and Business

## Appointments

MR. S. R. DONALDSON, A.M.I.E.E., has been appointed general manager of Newage (Manchester), Ltd.

MR. C. R. H. SIMPSON has been appointed assistant to the technical sales manager of Beyer Peacock and Co., Ltd.

MR. D. F. CAMPFIELD has been appointed national sales manager, photo records division, Remington Rand, Ltd.

MR. V. H. F. HOPKINS has been appointed manager of engineering, diesel engine division, of the English Electric Company, Ltd.

THE NATIONAL UNION OF MANUFACTURERS announces that Mr. Victor Berry has been appointed secretary of their South Wales branch.

G. AND J. WEIR, Ltd., announces that Mr. J. W. Atwell, M.Sc., M.I.Mech.E., has been appointed assistant managing director of the executive board.

VERITY'S, Ltd., announces that Mr. J. W. Seymour, B.Sc. (Eng.), has been appointed a director of the company and Mr. P. J. H. Coates, A.M.I.E.E., has now become managing director.

LONDON TRANSPORT has announced that Mr. L. C. Lloyd has been appointed assistant works superintendent (Aldenham) in the department of the chief mechanical engineer (road services).

THE MINISTRY OF SUPPLY has announced that Mr. J. Cushny has been promoted to director (engineer) and appointed chief engineer, Royal Aircraft Establishment, Farnborough.

MR. C. G. REDDINGTON, A.M.I.C.E., district engineer, King's Cross, has been appointed planning officer (King's Cross), in the office of the general manager, Eastern Region, British Railways, Liverpool Street.

CROMPTON PARKINSON, Ltd., announces that Mr. H. Astbury, M.I.E.E., the firm's chief engineer, having reached normal retiring age, has relinquished his appointment which he has held since 1945. He will, however, continue with the company in an advisory capacity. He is succeeded by his deputy, Mr. W. A. McNeill, B.Sc. (Tech.), M.I.E.E.

H. LEVERTON AND CO., Ltd., Caterpillar dealers for the northern half of England, announces the appointment of three area sales managers. They are : Mr. M. Cummins (Leeds), Mr. J. A. Needham (Wigan), and Mr. R. C. Eltringham (Gateshead). Each sales manager will be responsible to Mr. J. G. Smith, the northern area sales director of Levertons.

THE NATIONAL COAL BOARD announces that it has appointed Mr. C. G. Simpson, O.B.E., to be its director-general of staff, and Mr. J. V. Wood, director-general of industrial relations. Mr. Simpson, who is at present deputy director-general of the staff department, succeeds Mr. J. O. Blair-Cunynghame, O.B.E., who was recently appointed by the Minister of Power to be a member of the Board. Mr. Simpson's appointment takes effect immediately. Mr. Wood, the staff director of the Board's northern division, will succeed Mr. A. Walsh, M.B.E., who is to become deputy chairman of the south-western division. Mr. Wood will take up his new appointment on November 18.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., announces that Mr. H. C. Young has relinquished his duties as superintendent, Erection Department, but will remain in the service of the company as consulting engineer. Mr. A. P. Mitchell succeeds him as superintendent, Erection Department. Mr. W. Harper has been appointed assistant superintendent (Switchgear) Erection Department, and Mr. A. D. Millar assistant superintendent (Plant) Erection Department. Mr. B. G. Churcher has relinquished his position as manager of the Research Department but will continue to act in an advisory capacity. Dr. J. M. Dodds, O.B.E., M.A., B.Sc., B.Sc. (Eng.), Dr.-Ing. (Aachen), succeeds him as manager of the Research Department. Mr. M. Bird, A.M.I.E.E., assistant superintendent Insulation Department, has been appointed superintendent Insulation Department and Bury factory. Mr. D. B. Johnston, B.Sc. (Eng.), A.M.I.E.E., has been appointed assistant superintendent Plant Department, and Mr. N. Bradshaw has been appointed assistant superintendent, Foundries and Pattern Shop. Mr. P. O'B. Hove, B.Sc. (Eng.), A.M.I.E.E., A.M.I. Mech.E., has been appointed resident manager, Middle East, of the Metropolitan-Vickers Electrical Export Company, Ltd. ; he will be located in Baghdad, Iraq.

## Business Announcements

G. APPLEGATE AND SONS, LTD., states that it has opened an office and works at Manvers Street, Bath (telephone, Bath 64147).

JENOLITE, LTD., has announced the appointment of Mr. V. Kronman, Nybrogade 14, Copenhagen K, as its new licensee and agent in Denmark.

PILOT WORKS, Ltd., of Bolton, has appointed the S.M.T. Sales and Service Company, Ltd., as their sole distributors for hydraulic tipping gears in Scotland.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., announces that, as and from August 31, 1957, the telephone number of the Edinburgh branch office will be Caledonian 6786/7/8.

COSTAIN-JOHN BROWN, LTD., states that it has opened a branch office of the instrumentation division at Jaffrey's Chambers, 63, Brown Street, Manchester, 2 (telephone, Blackfriars 5575).

WOLF ELECTRIC TOOLS, Ltd., announces that Mr. G. M. Wolfe, joint managing director of the company, sets out in mid-September on a three months' tour which will include visits to Canada, New Zealand, Australia, Malaya, Thailand and India.

THE HANWELL ENGINEERING COMPANY, Ltd., of Countess Road, Northampton, has been taken over by Pollard Bearings, Ltd., and the title of the company is now changed to Pollard Bearings (Northampton), Ltd. The telephone number remains as at present—Northampton 3766/7/8.

THE PRESIDENT OF THE BOARD OF TRADE, the Rt. Hon. Sir David Eccles, K.C.V.O., has this month accepted the award by the Council of the British Institute of Management of an honorary fellowship of the Institute. An honorary fellowship of the Institute is the highest award the council can offer and this is only the third time such an award has been made.

NEWALL GROUP SALES, Ltd., announces that the Newall Engineering Company, Ltd., of Peterborough, England, have formed a Canadian subsidiary company, The Newall Machine Tool Corporation of Canada, Ltd. The new company will be empowered to distribute in North America and to manufacture products of the parent organisation; the new company is registered in Toronto.

THERMOTANK, LTD., has announced that the address of its London office, with effect from September 2, will be the Marine Engineers' Memorial Building, 18, London Street, London, E.C.3 (telephone, Royal 7343-4). The telephone number of the offices and works of the Thermotank group at West Drayton, Middlesex, is to be changed to West Drayton 3685-9, also with effect from September 2.

HEAD WRIGHTSON PROCESSES, Ltd., of London, announces that an agreement has been signed with Inventa A.G., of Lucerne, Switzerland, which will enable the company to design and supply plants to the Inventa processes for the production of methanol and formaldehyde, in the United Kingdom and British Commonwealth (excluding Canada), and can now offer a complete service for the provision of these plants, from the design to the final commissioning.

D. NAPIER AND SON, Ltd., has contracted with R.E.A.L. S.A. Transportes Aereon, Brazil, for the conversion of three "Convairliner 340" aircraft to Napier "Eland" engines. The machines are expected to be flying by the end of 1958, and satisfactory operation will be followed by the conversion of the remainder of the "Convair 340" and "Metropolitan" machines. The conversion will be carried out by PacAero Engineering Corporation at Santa Monica, commencing August, 1958. Either the existing "Eland-Convairliner" or a "440" shortly to be converted to turbines will be used by R.E.A.L. for crew training and route familiarisation.

## Contracts

GLENFIELD AND KENNEDY, Ltd., Kilmarnock, has received an order valued at over £150,000, from the Ministry of Defence of the Republic of India, for all the large valves for the dry dock that is to form part of the new Naval Dockyard in Bombay.

CROMPTON PARKINSON, Ltd., announces that a further order has been received for eighteen electric traction equipments under the British Railways modernisation plan. The equipments are for type "B" diesel-electric locomotives of 1160 h.p., for freight and passenger services, which are to be built by the Birmingham Railway Carriage and Wagon Company, Ltd.

THE BRITISH TABULATING MACHINE COMPANY, Ltd., has received an order from the Durban City Council for a Hollerith type 1201 electric computer. The computer will be used for producing light and telephone accounts, at a rate of 1000 an hour, and will prepare municipal employees' paysheets and leave records. The city treasury calculates that, by diverting staff to more productive jobs, this computer will save ratepayers some £37,500 a year. Durban has a population of half-a-million.

ESSO PETROLEUM COMPANY, Ltd., announces that it has entered into an arrangement with Union Carbide, Ltd., whereby it will supply ethylene gas to the new £3,000,000 petrochemical plant which Union Carbide, Ltd., proposes to construct on a 52-acre leased site adjacent to the Esso refinery at Fawley. This new plant, scheduled for completion by 1959, will convert ethylene into a number of ethylene oxide derivatives. The Esso Petroleum Company will produce the ethylene in its new £9,000,000 chemical plant now under construction at the refinery.

THE BRITISH THOMSON-HOUSTON COMPANY has received a contract valued at nearly £100,000 for the largest blast-furnace turbo-blower supplied by the company for installation overseas. The order, which also includes condensing plant, is for the Algoma Steel Corporation of Canada, and was received through British Thomson-Houston Company (Canada), Ltd., of Toronto. The plant is normally rated at 85,000 cubic feet per minute, 30 lb per square inch gauge, but will be capable of dealing with the maximum volume of 100,000 cubic feet per minute at a discharge pressure of 20 lb per square inch gauge.

## Miscellanea

FIVE 200MW GENERATING SETS FOR WEST THURROCK POWER STATION.—The Central Electricity Authority has received the consent of the Minister of Power to the building of a new power station at West Thurrock, Essex, which will have an installed capacity of 1000MW. The installation will comprise five 200MW turbo-generator sets and five 200MW reheat boiler units, each having an evaporative capacity of 1,400,000 lb of steam an hour. The West Thurrock station is planned to be in commission by the winter of 1961.

BRITISH NUCLEAR EXHIBITS AT LEVANT FAIR.—The Board of Trade has arranged a display for the twenty-first Levant Fair, Bari, Italy, which is to be held from September 7 to 25, 1957. The display has been designed in conjunction with the U.K. Atomic Energy Authority and in consultation with industry. Models of Calder Hall and of the fast breeder reactor at Dounreay will be on view. Emphasis will be placed on British collaboration with other nations, and the readiness of British industry to meet world demand for nuclear equipment. A British film with an Italian sound track will show how a thermal reactor works.

FRENCH CO-OPERATION IN INDIAN RAILWAYS' ELECTRIFICATION.—French Railways, under a recent agreement, are to give technical assistance to the Indian Railways for the electrification of some 600 miles of line carrying heavy traffic in the Calcutta area. The system adopted for this project is that using single-phase current, at the industrial frequency as developed by the French Railways since the war. The agreement provides for close co-operation on the planning of the project, framing of specifications, negotiations with and the choice of contractors, the supervision of works, &c. French Railways also undertake to train Indian Railways' technicians in France, and to keep French technicians in India for a year after the electrification of each section of line to ensure that the equipment is working satisfactorily and that its maintenance is well organised.

CONFERENCE ON INDUSTRIAL CARBON AND GRAPHITE.—The Society of Chemical Industry is to hold a three-day conference on industrial carbon and graphite at the William Beveridge Hall, University of London, on September 24, 25 and 26. More than fifty papers have been submitted from Britain and abroad, and it has been decided to summarise them in selected groups so as to permit full discussion. Interest in the conference is reported from the U.S.A., U.S.S.R., France and the Netherlands. Prior registration for membership of the conference is possible through the assistant secretary, Society of Chemical Industry, 14, Belgrave Square, London, S.W.1, or the hon. secretary of the Conference Committee, Mr. E. A. Smith, Acheson Industries (Europe), Ltd., 18, Pall Mall, London, S.W.1. Members receive a set of preprints of the papers. A free exhibition will be held in the Department of Chemical Engineering, University College, Gower Street, London, W.C.1, during the period of the conference.

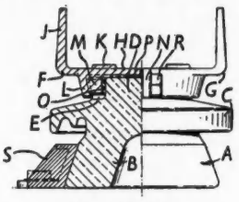
# British Patent Specifications

*When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.*

## ELECTRICAL ENGINEERING

**779,450.** April 25, 1956.—INSULATING SUPPORTS FOR ELECTRIC CONDUCTOR RAILS, Doulton and Co., Ltd., Doulton House, Albert Embankment, Lambeth, London, S.E.1. (*Inventor: Frank Audrey Hill.*)

The invention relates to insulating supports for electric conductor rails and in particular to supports for the conductor rails of electric railway systems. Referring to the drawing, an insulator body *A* is

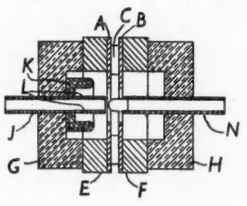


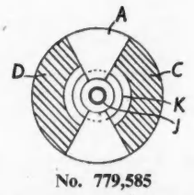

No. 779,450

formed with a skirt or base portion *B*, a shed *C* and a head *D*. The head is generally an inverted truncated cone in shape and is formed with a pair of diametrically opposed radial slots *E*. A metal cap comprises two halves *F* and *G* which are identical in shape and therefore only one will be described in detail. The half *F* includes a semi-circular platform *H* from which extends an upright side wall *J* which engages with one side of a conductor rail. The rail rests on a raised pad *K* on the platform. A semi-circular flange *L* extends downwardly and inwardly inclined from the platform and surrounds one-half of the head. A projection *M* extends inwardly from the flange *L* and is received within the slot *E*. Extending from each end of the flange in an outwardly radial direction is a lug *N* which is provided with holes. It will be seen that the two halves *F* and *G* produce a cap with a recessed underpart adapted to fit on the head of the insulator body. A collar *O* surrounds the conical head *D* and acts as a cushion between the fitting portions of the head of surrounding flanges. A washer *P* is also interposed between the top of the head and the lower surface of the platform also acts as a cushion. The two halves of the cap are clamped together, with the flanges surrounding the conical head, by bolts *R*. The insulator body *A* is secured to the railway sleeper by means of a pair of clamping elements *S* which engage with the base of the skirt and are secured to the sleeper by coach screws. From the description it will be realised that in an insulating support, according to the invention, the cap is secured to the insulator body without the use of cement or the like, and should it be desired to replace either the insulator body or the cap, either of these parts may be detached and replaced without damage to the other.—*July* 17, 1957.

**779,585.** October 5, 1954.—BLOWN DISCHARGE GAP SWITCH, Metropolitan-Vickers Electrical Company, Ltd., St. Paul's Corner, 1–3, St. Paul's Churchyard, London, E.C.4. (*Inventor: Colin Robert Dunbar.*)

The invention relates to blown discharge gap switches for use with pulse modulator circuits and the

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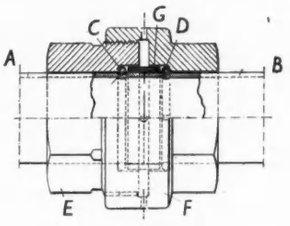
like. The object of the invention is to provide a blown discharge gap switch which overcomes excessive electrode and trigger wear and which can be used at higher pulse repetition rates. Referring to the drawing, the cathode is in the form of two metal plates *A* and *B*, each of which has two pole pieces extending towards the centre. The plates are spaced by two distance pieces *C* and *D* to provide two channels for air exits. *E* and *F* are rings of metal, conveniently brass, through which inlets or outlets for air may be made. The cathode plates, distance pieces and metal rings, together with insulating end pieces *G* and *H*, which are of material such as "Perspex," are firmly bolted together so as to form a cylindrical chamber. End piece *G* has a tapped hole in its centre through which is screwed a trigger electrode *J*. The trigger electrode is a metal tube through which air can be blown, and it carries a cup *K*, also of material such as "Perspex," which serves to deflect air coming through holes *L* into the gap between trigger and cathode. End piece *H* is also tapped and into it is screwed an anode *N* so that it faces the trigger and is situated on the same axis. The anode may be either a metal rod or tube with a rounded end, but the most satisfactory form is that shown in the drawing, where a tube having a solid metal end piece is employed. The method of operation of the switch is that when a trigger voltage pulse is applied between the trigger and anode electrodes breakdown occurs and is followed by the breaking down of the gap between anode and cathode; the discharge passing from anode to trigger and then from trigger to cathode. The actual mechanism of the main anode to cathode breakdown is uncertain but it may be that: (*a*) the trigger pulse ionises the air in the main gap; or (*b*) the ultra-violet light generated by the trigger-anode breakdown causes photo-emission at the cathode. The excessive wear of trigger electrodes experienced in previous designs of blown discharge gap switch caused by the main discharge passing from anode to cathode via the trigger electrode, is reduced in the present invention owing to the large surface area of the tubular trigger electrode. Modified designs with various air path arrangements are also shown in the specification.—*July* 24, 1957.

## TUBE AND PIPE CONNECTIONS

**779,007.** July 21, 1952.—PIPE JOINTS, Edmund Gressel, 154, Schulstrasse, Aadorf, Thurgau, Switzerland.

The invention relates to a process which enables a reliable fluid tight joint to be made between pipes without the use of packing even under high internal pressures. The two pipes to be connected *A* and *B* each has approximately at the end a steel spring ring



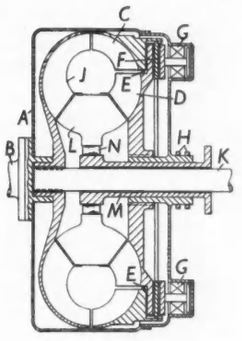

No. 779,007

*C*, *D*, in grooves. The rings are sprung into the grooves after the two nuts *E* and *F* have been pushed on to the pipes. The spring rings are prevented from slipping out of the grooves by the tightening nuts. The opposed end faces of the pipes can be turned or ground smooth to form sealing faces. When the nuts are tightened they push the pipes together with the aid of the spring rings to seat themselves on each other under pressure without the use of any additional sealing means. A sleeve *G* may be disposed over the ends of the pipes and between the rings. Holes in the wall of the tightening nut make it possible, when the pipes are in use, to ascertain whether the connection is fluid-tight.—*July* 17, 1957.

## POWER TRANSMISSION

**780,983.** July 16, 1954.—HYDRAULIC TORQUE CONVERTERS, The Rover Company, Ltd., Meteor Works, Lode Lane, Solihull, Birmingham. (*Inventor: Maurice Fernand Cary Wilks.*)

The invention relates to hydraulic torque converters for road vehicles and comprising a rotary-vaned driving pump, a driven turbine, and an intermediate reaction member. Its object is to provide an improved construction, whereby high efficiency of power transmission can be obtained over a wide range of speed variation. Referring to the drawing, a hollow rotary housing *A* is secured to the driving shaft *B*. The pump consists of two separate and concentric vaned parts *C* and *D*, designed to be equivalent to a single vaned pump of conventional form. The inner part *D* is secured to, or forms an integral part of, the housing. The outer part *C* is supported on the inner part by a ring of bearing balls *E*, and is coupled to the part *D* through a clutch *F*. As shown, the clutch is operated by electromagnets *G*, the windings of which can be supplied with current through slip rings *H* on the housing. In association

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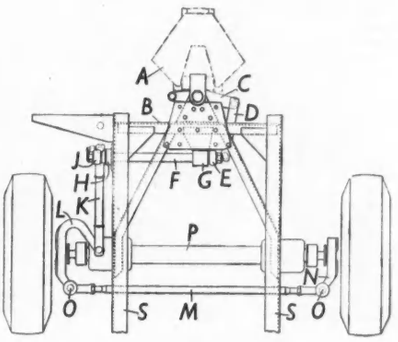
with the pump are arranged in the usual manner the turbine *J*, which is secured to the driven shaft *K*, and the reaction member *L*, which can be coupled to a fixed sleeve *M* by a clutch *N*. The arrangement is such that under heavy load, and when a relatively large difference of speed exists between the driving and driven shafts, the pump parts *C* and *D* are interconnected by the clutch *F*. In this condition the parts operate jointly in the same manner as a single pump. Under light load conditions, and when a relatively small difference of speed exists between the driving and driven shafts, the clutch *F* is released and the part *D* then provides the required pumping action, the part *C* being free to rotate idly under the action of the liquid flowing between its vanes.—*August* 14, 1957.

## ROAD TRANSPORT

**781,304.** September 30, 1954.—TRAILER VEHICLES, Crossley Motors, Ltd., Errwood Park, Stockport. *Inventor: Frederick Ernest Randle.*

The invention has for its object to provide a steering mechanism for low-loading trailer vehicles, and provides for correct action of the trailer front wheels to prevent tyre scrub. As shown in the drawing, the trailer vehicle is attached to the towing vehicle by the drawbar *A* which is pivoted to the front frame member *B* of the trailer to turn about a vertical axis. Attached to the drawbar is a short lever *C* extending to one side at an angle of about 90 deg. to the drawbar. At the end of the lever is pivoted a link *D* leading to an arm *E*, which extends downwards from one end of a steering shaft *F*. This shaft is mounted in bearings *G* and *H* under the trailer floor and extends transversely. It is turned by the arm *E* as the drawbar *A* pivots when the towing vehicle turns a corner. At the other end of the steering shaft *F* near the side of the trailer

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another arm *J* extends down with its lower end slightly ahead of the lower end of the first arm *E*. The arm *J* is attached at its lower end to a link *K* to a steering lever *L* on a wheel mounting, the lever being connected by a track rod *M* to a steering lever *N* for the other wheel. The levers *L* and *N* are connected to the track rod *M* by ball joints *O*. The wheel mountings are pivotally attached to an axle on which the trailer is suspended by springs. The dimensions and design of the drag link, the steering levers and the track rod are such as to give relative angular displacements of the two road wheels to ensure satisfactory cornering. It will be seen that the steering equipment is located entirely below the trailer floor, carried by the front member *B* and the side frame members *S*.—*August* 14, 1957.

## Launches and Trial Trips

CITY OF GUILFORD, cargo ship ; built at Wallsend by Swan, Hunter and Wigham Richardson, Ltd., for the Ellerman Lines, Ltd.; length between perpendiculars 405ft, breadth moulded 59ft, depth moulded to shelter deck 36ft 9in, load draught 24ft 6in, deadweight 7400 tons, service speed 14¼ knots ; four holds deep tanks, derrick complement include one 70-ton and 10-ton and 7-ton derricks, electric winches, three 180kW diesel-driven generators ; Clark-Sulzer single-acting, two-stroke diesel engine, eight cylinders, 720mm diameter by 1250mm stroke, 5040 b.h.p. at 121 r.p.m. Launch, June 27.

LONDON RESOLUTION, oil tanker ; built by the Furness Shipbuilding Company, Ltd., for London and Overseas Freighters, Ltd.; length between perpendiculars 560ft., breadth moulded 80ft, depth moulded 42ft 3in, deadweight 24,800 tons on 32ft 4in summer draught ; designed trial speed 14¼ knots ; twenty-seven cargo oil tanks, one main cargo pump room, three 1000 tons per hour turbine-driven cargo oil pumps, three 150 tons per hour vertical duplex stripping pumps, steam cargo winches ; two 325kW turbine-driven generators, one 100kW diesel-driven generator ; one set of Richardsons Westgarth double reduction geared turbines, 7300 s.h.p. at 100 propeller r.p.m., two Foster-Wheeler "D" water-tube boilers supply steam at 450 lb per square inch and 750 deg. Fah. Launch, June 27.

MOUNT EDEN, trawler ; built by John Lewis and Sons, Ltd., for North Eastern Fisheries, Ltd.; length between perpendiculars 120ft, breadth 25ft, depth 12ft 6in ; fish room 7000 cubic feet, electric trawl winch, capacity 1000 fathoms of 2¾in warp ; Mirrlees K.S.S.6 diesel engine, 712 b.h.p. at 220 r.p.m. Trial, June 27.

EASTGATE, oil tanker ; built by Joseph L. Thompson and Sons, Ltd., for the Turnbull Scott Shipping Company, Ltd.; length between perpendiculars 530ft, breadth moulded 69ft 3in, depth moulded 39ft, deadweight 18,000 tons on 29ft 6in draught ; thirty-three cargo oil tanks ; one set of Wallsend Slipway double reduction geared turbines, 7500 s.h.p. at 100 propeller r.p.m., service speed 14½ knots. Launch, June 29.

PURMEREND, oil tanker ; built by the Netherlands Dock and Shipbuilding Company, Ltd., for N.V. Amsterdamse Maritiem Transport Maatschappij ; length between perpendiculars 530ft, breadth 69ft 3in, depth 39ft, deadweight 18,000 tons ; thirty-three cargo oil tanks ; one set of Werkspoor geared turbines, 8300 s.h.p. Launch, June 29.

## Catalogues and Brochures

G. AND J. WEIR, Ltd., Cathcart, Glasgow, S.4.—Leaflet illustrating and describing "Thermoflex" heating elements for sea water evaporators.

LANCASHIRE DYNAMO AND CRYPTO, Ltd., Trafford Park, Manchester, 17.—Illustrated catalogue describing geared motor units, 1 h.p. to 60 h.p.

DESOUTTER BROTHERS, Ltd., The Hyde, Hendon, London-N.W.9.—Loose-leaf catalogue describing and illustrating light-weight pneumatic tools.

PEGSON, Ltd., Coalville, Leicestershire.—Leaflet giving general information about heavy-duty four-bearing screens and "Live Wire" vibrating screens.

BRITISH WOOD PRESERVING ASSOCIATION, 6 Southampton Place, London, W.C.1.—Leaflet No. 9, entitled "Wood Preservatives of the Organic Solvent Type."

D. ROBINSON AND CO., 58, Oaks Avenue, Worcester Park, Surrey.—Illustrated catalogue giving technical details of the range of relays manufactured by the company.

SIMPLIFIX COUPLINGS, Ltd., 157, Victoria Street, London, S.W.1.—Catalogue illustrating and describing some present-day applications of "Simplifix" compression joints.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., General Chemicals Division, Millbank, London, S.W.1.—Booklet dealing with metal degreasing by the Trichloroethylene process.

BRITISH BITUMEN EMULSIONS, Ltd., Dundee Road, Trading Estate, Slough, Bucks.—Pamphlet giving details of "Kyljack" accelerator and hardener for concrete and mortar mixes.

COURTBURN POSITIONERS, Ltd., Bedford.—Loose leaf folder containing details of work handling equipment for welding operations, including rotators, positioners, operators' platforms, clamps and vices.

VOKES, Ltd., Henley Park, Guildford, Surrey.—Pamphlet on the tests made by this company to determine the most suitable kind of air filter for electric and diesel-electric railway locomotive use in industrial areas.

OZALID COMPANY, Ltd., 62, London Wall, London, E.C.2.—Illustrated leaflet describing the "Ozamajor" combined table top exposing and dry developing unit, capable of reproducing drawings up to 45in in width.

CHANCERY INSULATIONS, Ltd., 93–94, Chancery Lane, London, W.C.2.—Leaflet describing the "Seel" incombustible roof lining. The lining is applied by spraying and consists of asbestos fibres which are bonded to the sheeting, eliminating any air space.

ENGINEERING DIAMONDS, Ltd., 26, Warwick Row, Coventry.—Leaflet dealing with a precision dressing slide unit, model PDS.29. It is said to be applicable to almost any kind of grinding machine for the purpose of dressing angular faces.

PETER LIND AND CO., Ltd., Romney House, Tufton Street, Westminster, London, S.W.1.—Illustrated book entitled "Concrete Achievements," issued to commemorate the fortieth anniversary of the company. The book is a pictorial survey of work completed.

BRITISH IRON AND STEEL RESEARCH ASSOCIATION, 11, Park Lane, London, W.1.—Booklet entitled "Computers and Steel," by D. G. Owen. This booklet is designed to explain the operation of electronic computers, and some of the ways in which they can be of use to the steel industry.

THE FEDERATION OF CIVIL ENGINEERING CONTRACTORS, Romney House, Tufton Street, Westminster, London, S.W.1.—Leaflet entitled "Training Schemes in the Civil Engineering Industry." Details are given about the practical training of young engineers and the training of contractors' plant mechanics.

W. J. MEDDINGS, Ltd., 16, Berkeley Street, London, W.1.—Illustrated catalogue giving technical details of "Pacera Maxam" air hydraulic feed unit. Designed to operate from normal factory airline pressures, it is intended mainly for the conversion of drilling machines from manual to power operation.

HELLEFORS BRUKS AKTIEBOLAG, Hellefors, Sweden (Ernst B. Westman, Ltd., 39, Lombard Street, London, E.C.3).—Booklet giving details of "Remko" magnetic iron. It is described as an exceptionally soft, pure iron of uniform composition and properties, characterised by very low coercive force and high induction. It is claimed to be especially suitable for the manufacture of frames, yokes, armatures and cores in telephone relays.

THE LARMAR ENGINEERING COMPANY, Ltd., Margaretting, Ingatestone, Essex.—Leaflet giving details about the "Larmar" turret speeder. This fitting is designed for speeding up the movement of the capstan turret ; it is fitted to one of the arms of the star wheel, and at a short radius from the centre of the hub to make operation easier. It is supplied ready for fitting to Ward, Herbert and other makes of capstans, turret lathes, and various machine tools.

THE GENERAL ELECTRIC COMPANY, Ltd., Component Sales Department, Osram Lamp Works, East Lane, Wembley, Middlesex.—Illustrated brochure describing some of the metallic materials and their uses, manufactured by the company. The booklet has sections dealing with tungsten, molybdenum, molybdenum-tungsten alloys, other metals and alloys supplied as wire, lead wires, filament coils and filament supports, diamond powder and diamond dies, and heavy alloys.

BRITISH GEON, Ltd., Devonshire House, Piccadilly, London, W.1.—Technical booklet No. H.1., describing the "Hycar" series of oil-resisting synthetic rubbers. Summary Sheet No. 3 of "Hycar" nitrile rubbers and lattices. Booklet No. G.5, entitled "Geon Vinyl Compounds," describes the range of compounds made from Geon vinyl resins. Details are also given of the properties, use and processing of the compounds ; included also are recommended process conditions for extruding and for injection moulding, and special reference is made of compounds specifically formulated to meet electrical specifications.

## Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

*Mon., Sept.* 2.—SHEFFIELD BRANCH : Royal Victoria Station Hotel, Sheffield, Chairman's Address, 7.15 p.m. ★ N.E. LONDON BRANCH : Angel Hotel, Ilford, "Any Questions ?" 8 p.m.

*Tues., Sept.* 3.—S.E. LONDON BRANCH : Eltham Congregational Church Hall, Court Road, London, S.E.9, "Instrumentation of Industrial Boiler Plant," L. F. Cohen, 7.15 p.m. ★ W. LONDON BRANCH : Windsor Castle Hotel, Hammersmith, London, W.6, "Safety Precautions on Building Sites," J. A. Haywood, 7.30 p.m.

*Wed., Sept.* 4.—GLASGOW BRANCH : Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.3, "The Cathode-Ray Tube," Film, 8 p.m. ★ MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, "The Modern Diesel Engine," T. E. Draper, 7 p.m. ★ N. LONDON BRANCH : Queen's Head, 677, Green Lanes, Harringay, London, N.4, "Earth Leakage Equipment," J. Robbins, 7.45 p.m. ★ PRESTON BRANCH : R.A.F.A. Club, East View, Preston, "Fire-Fighting and Accidents in the Home," O. C. Budd, 7.30 p.m.

*Thurs., Sept.* 5.—SOUTHAMPTON BRANCH : Polygon Hotel, Southampton, "Electrical Accidents and Factory Regulations," S. J. Emerson, 8 p.m.

*Fri., Sept.* 6.—LIVERPOOL BRANCH : Liverpool Engineering Society, 9, The Temple, 24, Dale Street, Liverpool, Chairman's Address, A. Robertson, 6.30 p.m.

### ENGINEERING, MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION

*To-day to Thurs., Aug.* 30 *to Sept.* 12.—Olympia, Hammersmith Road, London, W.14, open daily 10 a.m. to 6 p.m., Fridays 10 a.m. to 8 p.m.

### ENGINEERS' GUILD

*Fri., Sept.* 20.—S. WALES AND MONMOUTHSHIRE BRANCH : Old Arcade Inn, Church Street, Cardiff, Luncheon, 12.45 p.m.

*Thurs., Sept.* 26.—METROPOLITAN BRANCH : Caxton Hall, Caxton Street, Westminster, London, S.W.1, Annual General Meeting, Discussion on "The Aims and Future Policy of the Guild," 6 p.m.

### INCORPORATED PLANT ENGINEERS

*Tues., Sept.* 3.—LONDON BRANCH : Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2, "Maximum Demand and Power Factor and their Effect on the Electricity Tariff," T. A. Williams, 7 p.m. ★ EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, Members' Evening, 7 p.m.

*Wed., Sept.* 4.—LEICESTER BRANCH : Bell Hotel, Leicester, "The Painting of Buildings," R. Woodwards, 7 p.m.

*Mon., Sept.* 9.—DUNDEE BRANCH : Mathers Hotel, Dundee, "Variable-Speed Drives with Voltage Regulation Equipment," 7.30 p.m. ★ MERSEYSIDE AND N. WALES BRANCH : The Blossoms, City Road, Chester, "The Cost Accountant and the Plant Engineer," R. G. Hall and B. J. Willson, 7.15 p.m.

*Tues., Sept.* 10.—MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, Chairman's "At Home," 7.15 p.m.

*Wed., Sept.* 11.—W. BRANCH : Grand Hotel, Bristol, "Fire Prevention in Industrial Buildings," 7.15 p.m.

*Thurs., Sept.* 12.—GLASGOW BRANCH : Scottish Building Centre, Glasgow, "The Design and Application of Rotary and Reciprocating Air Compressors," W. Scott, 7.15 p.m. ★ N.E. BRANCH : Roadway House, Oxford Street, Newcastle upon Tyne, "Internal Combustion Engines as Applicable to Plant Engineering," Norman Parry, 7 p.m.

*Tues., Sept.* 17.—BIRMINGHAM BRANCH : Hotel Leofric, Coventry, "Titanium as a Material of Construction in the Chemical Industry," K. W. J. Bowen, 7.30 p.m.

*Wed., Sept.* 18.—KENT BRANCH : King's Head Hotel, High Street, Rochester, Ladies' Film Evening, 7 p.m.

*Thurs., Sept.* 19.—BLACKBURN BRANCH : Golden Lion Hotel, Blackburn, Joint Meeting with Institute of Fuel, "Fuel and Power Position in the United Kingdom," Rear-Admiral Sir Sidney Frew, 7.30 p.m.

*Tues., Sept.* 24.—GLASGOW BRANCH : Scottish Building Centre, 425–427, Sauchiehall Street, Glasgow, Joint Meeting with the Institution of Heating and Ventilating Engineers, "Steam," and "Combustion and the Chain Grate Stoker," 7.15 p.m.

★ S. WALES BRANCH : South Wales Engineers' Institute, Park Place, Cardiff, "Metal Degreasing by Trichloroethylene," and "Metal Pretreatment in Industry," 7.15 p.m.

*Thurs., Sept.* 26.—SHEFFIELD AND DISTRICT BRANCH : Grand Hotel, Sheffield, "The Design of Rolling Mills, with particular reference to Hot and Cold Ferrous Mills." M. Langen, 7.30 p.m.

*Fri., Sept.* 27.—BIRMINGHAM BRANCH : Imperial Hotel, Temple Street, Birmingham, "Some Principles of Radiant Heating," P. A. Coles, 7.30 p.m.

*Mon., Sept.* 30.—W. AND E. YORKSHIRE BRANCH : Leeds University, "The Safe Use of Electricity," J. J. Emerson, 7.30 p.m.

*Tues., Oct.* 1.—E. MIDLANDS BRANCH : County Hotel, Theatre Square, Nottingham, "The Heat Pump : Some Aspects of its Application," J. A. Sumner, 7 p.m. ★ EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, "Practical Plant Engineering in the Chemical Industry," C. W. Winstock, 7 p.m. ★ PETERBOROUGH BRANCH : White Lion Hotel, Church Street, Peterborough, "Hydro-Electric Power Development," G. C. Cummings, 7.30 p.m.

*Wed., Oct.* 2.—LEICESTER BRANCH : Bell Hotel, Leicester, "Factory Flooring," F. C. Harper, 7 p.m. ★ SOUTHERN BRANCH : Royal Beach Hotel, Portsmouth, "The Engineer and the Clean Air Act," E. C. Rogers, 7.30 p.m.

*Tues., Oct.* 8.—MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, "Chain Grate Stokers," C. H. G. Hayward, 7.15 p.m.

*Thurs., Oct.* 10.—GLASGOW BRANCH : Scottish Building Centre, 425–427, Sauchiehall Street, Glasgow, "The Measurement and Prevention of Smoke from Industrial Boilers," T. F. Hurley, 7.15 p.m. ★ MANCHESTER BRANCH AND MERSEYSIDE AND N. WALES BRANCH : Joint Meeting, Aboard Clubship "Landfall," "What Purpose does Incorporated Plant Engineers Serve ?" 7.15 p.m. ★ N.E. BRANCH : Roadway House, Oxford Street, Newcastle upon Tyne, "The Manufacture of Tubes," H. B. Elliot, 7 p.m.

### INSTITUTE OF FUEL

*Wed., Oct.* 9.—Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, Symposium on "Flames and Industry," 10 a.m.

### INSTITUTE OF METALS

*Mon. to Fri., Sept.* 16 *to* 20.—Forty-ninth Annual Autumn Meeting, 1957, to be held in Glasgow.

### INSTITUTE OF THE MOTOR INDUSTRY

*To-day and Sat., Aug.* 30 *and* 31.—St. Catharine's College, Cambridge, Eleventh Annual Summer School.

### INSTITUTE OF PETROLEUM

*Wed., Sept.* 4.—26, Portland Place, London, W.1, "Some Developments in Marine Drilling Foundations," A. Kranendonk, 5.30 p.m.

### INSTITUTE OF PHYSICS

*Tues. to Thurs., Sept.* 10 *to* 12.—ELECTRON MICROSCOPY GROUP : University College of North Wales, Bangor, Annual Conference.

### INSTITUTION OF ENGINEERING DESIGNERS

*Mon., Sept.* 9.—N.E. BRANCH : Northern Architectural Association Hall, 6, Higham Place, Newcastle upon Tyne, Chairman's Address, Informal Discussion on Branch Affairs, 7.15 p.m.

*Mon., Oct.* 14.—N.E. BRANCH : Northern Architectural Association Hall, 6, Higham Place, Newcastle upon Tyne, "Building Structures," G. Gladstone, 7.15 p.m.

### INSTITUTION OF LOCOMOTIVE ENGINEERS

*Wed., Sept.* 25.—GENERAL MEETING : Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1, Presidential Address, E. S. Cox, 5.30 p.m.

### INSTITUTION OF MECHANICAL ENGINEERS

*Sat., Aug.* 31.—S. BRANCH : Whole-day visit to the pumping stations of the Mid-Wessex Water Company, Frimley, Surrey.

*Sat., Sept.* 14.—SOUTHERN BRANCH : Whole-day visit to the Greenham Common Base of the United States Air Force, Newbury, Berks, 10 a.m.

### INSTITUTION OF PRODUCTION ENGINEERS

*Wed., Sept.* 4.—COVENTRY GRADUATE SECTION : Visit to British Piston Ring Company, "Changing from Batch to Flow Production," H. C. Blackford, 7.15 p.m.

*Wed., Sept.* 18.—BIRMINGHAM SECTION : College of Technology, Gosta Green, Birmingham, 4, Film Evening, 7 p.m. ★ WOLVERHAMPTON GRADUATE SECTION : Wolverhampton and Staffs College of Technology, Wulfruna Street, Wolverhampton, "Nimonic Presswork," J. A. Grainger, 7.30 p.m.

*Tues., Sept.* 24.—OXFORD SECTION : Town Hall, Oxford, "Transfer Pressing," 7.30 p.m.

*Wed., Sept.* 25.—SHREWSBURY SECTION : Shrewsbury Technical College, Shrewsbury, "British Clock and Watch Production," R. Lenoir, 7.30 p.m.

*Thurs., Sept.* 26.—NORWICH SECTION : Norwich City College, Ipswich Road, Norwich, "S.G. Iron—A Versatile Engineering Metal," W. W. Braidwood, 7 p.m.

*Fri., Sept.* 27.—LEICESTER SECTION : Grand Hotel, Leicester, "Work Measurement and Its Uses for Management," W. Hewett, 7 p.m.

*Fri., Oct.* 4.—Dorchester Hotel, Park Lane, London, W.1, Annual Dinner.

### IRON AND STEEL INSTITUTE

*Wed. and Thurs., Sept.* 25 *and* 26.—IRON AND STEEL ENGINEERS' GROUP : Church House, Westminster, London, S.W.1, "Air Pollution in the Iron and Steel Industry."

*Tues., Sept.* 24.—4, Grosvenor Gardens, London, S.W.1, Autumn General Meeting, 10.45 a.m., to be followed by a Lecture at the Royal Institution, Albemarle Street, London, W.1, "The Future Engineering Development of the Gas-Cooled Nuclear Reactor," J. M. Kay, 6 p.m.

### MANCHESTER GEOLOGICAL AND MINING SOCIETY

*Thurs., Oct.* 10.—Mining and Technical College, Wigan, Annual General Meeting, 3.30 p.m.

### ROYAL AERONAUTICAL SOCIETY

*Fri., Sept.* 13.—FORTY-FIFTH WILBUR WRIGHT MEMORIAL LECTURE : Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, "Advanced Education and Academic Research in Aeronautics," Clark B. Millikan, 6 p.m.

### SOCIETY FOR WATER TREATMENT AND EXAMINATION

*Wed. to Fri., Oct.* 2 *to* 4.—Palace Hotel, Southend-on-Sea, Autumn Meeting.

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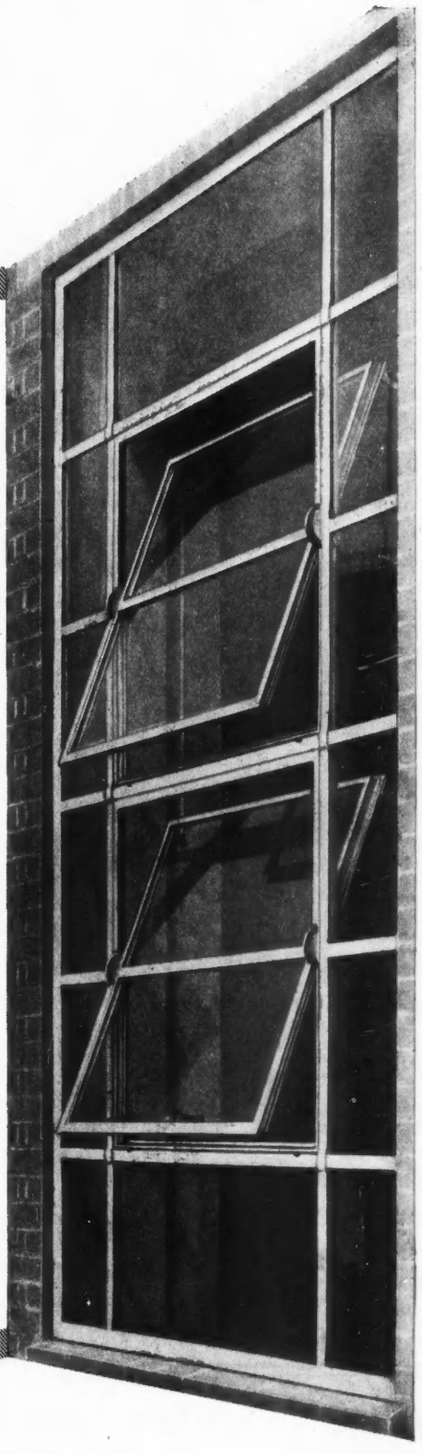

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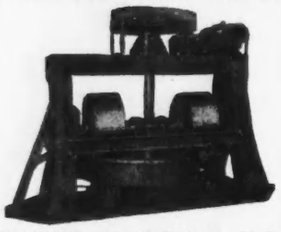

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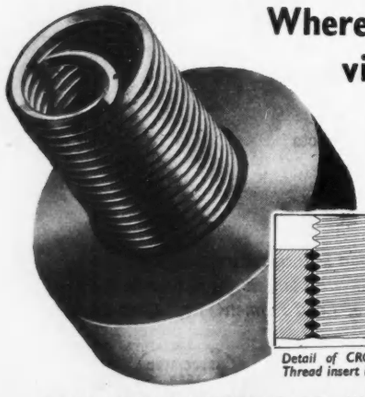

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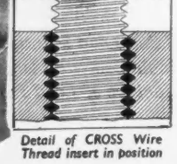

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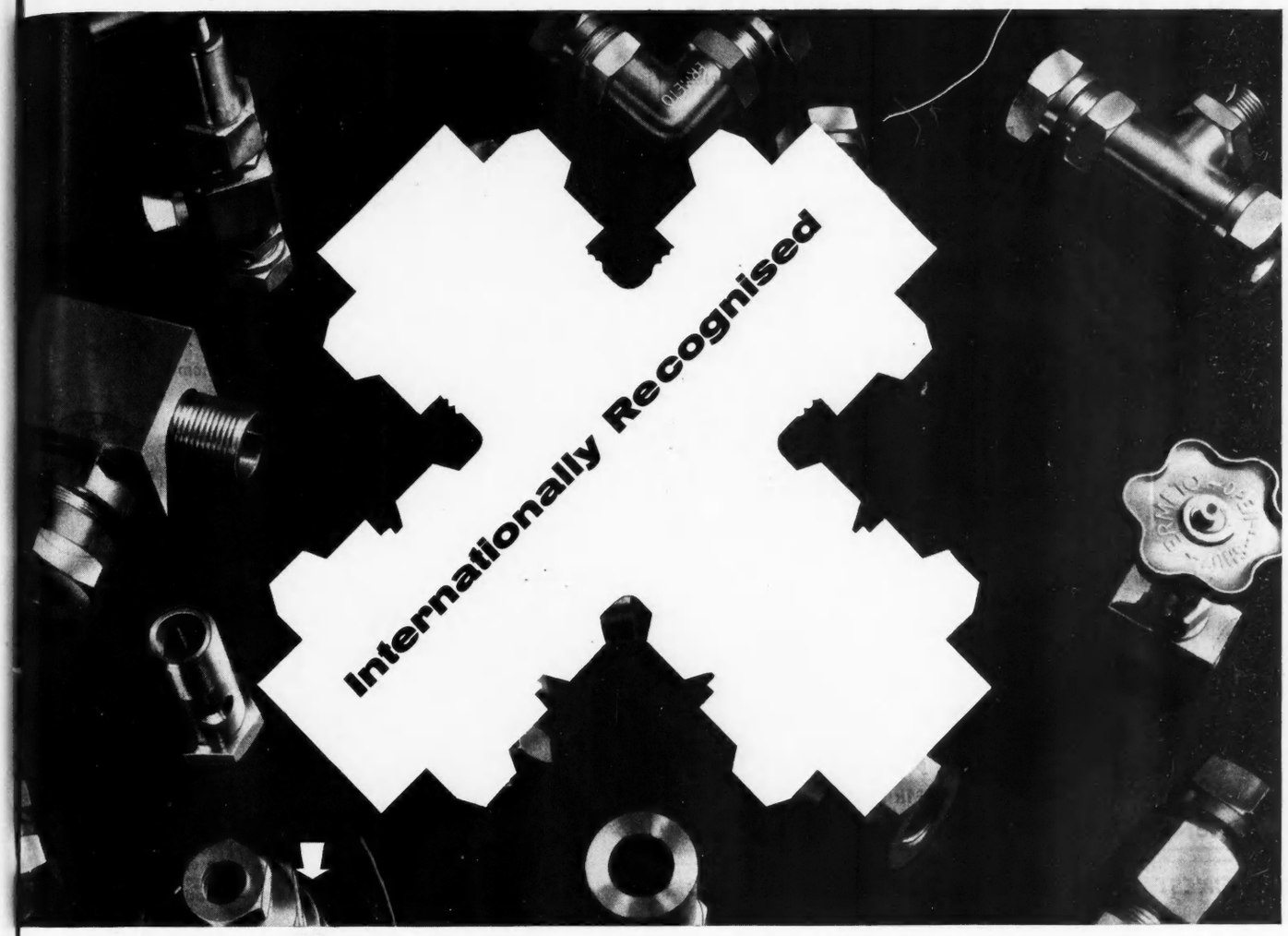


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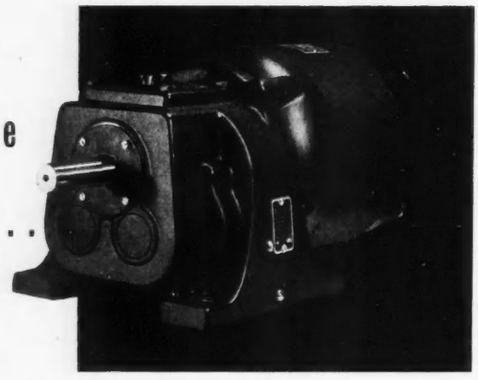

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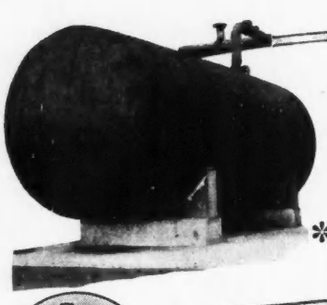

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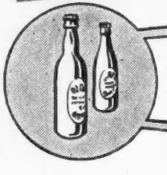

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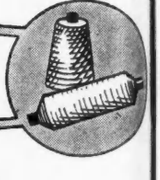

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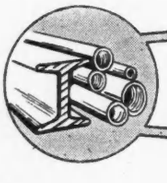

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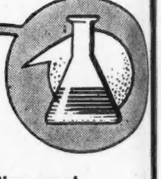

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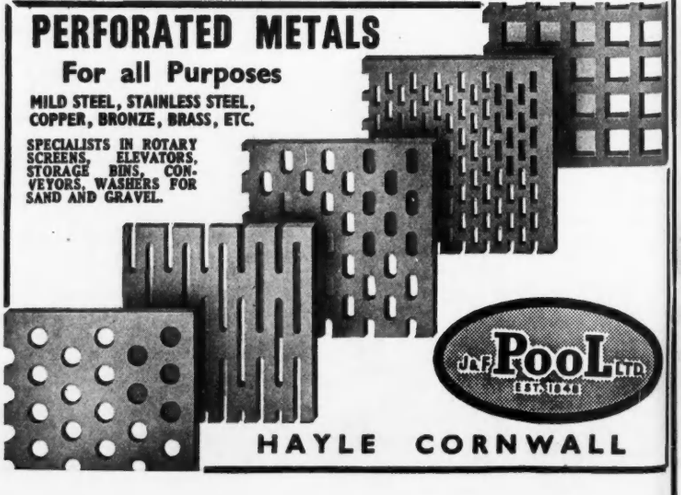

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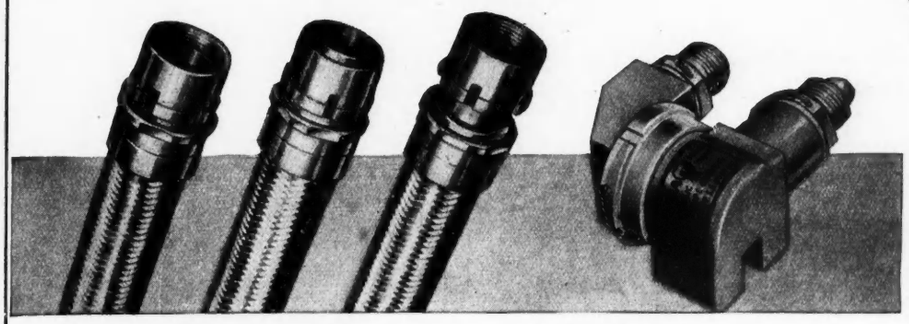

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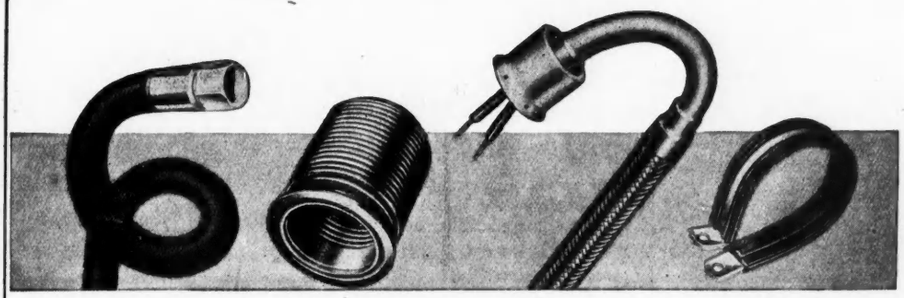

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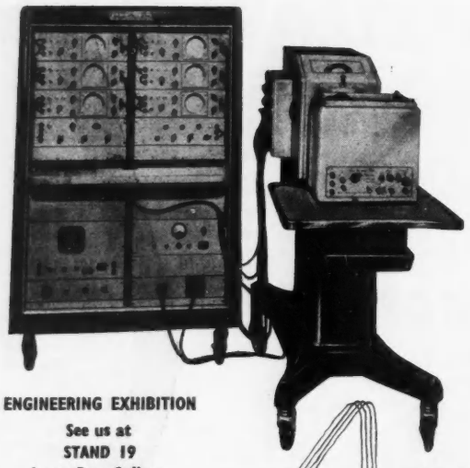

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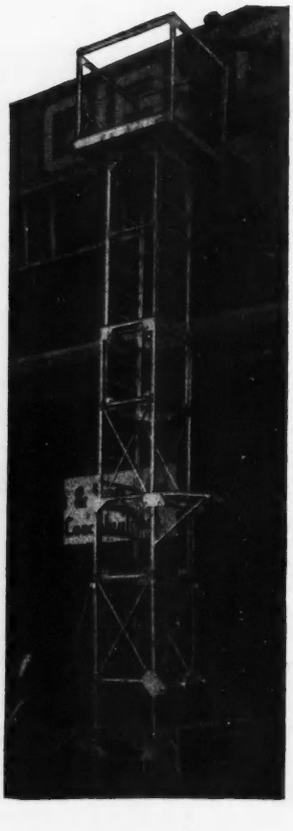

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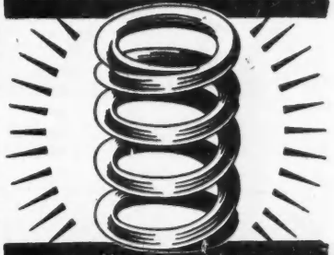

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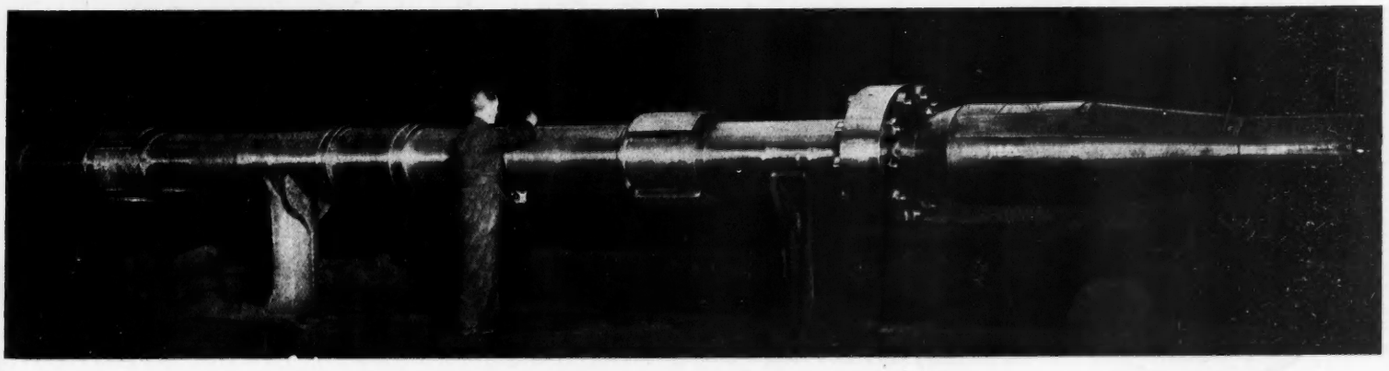

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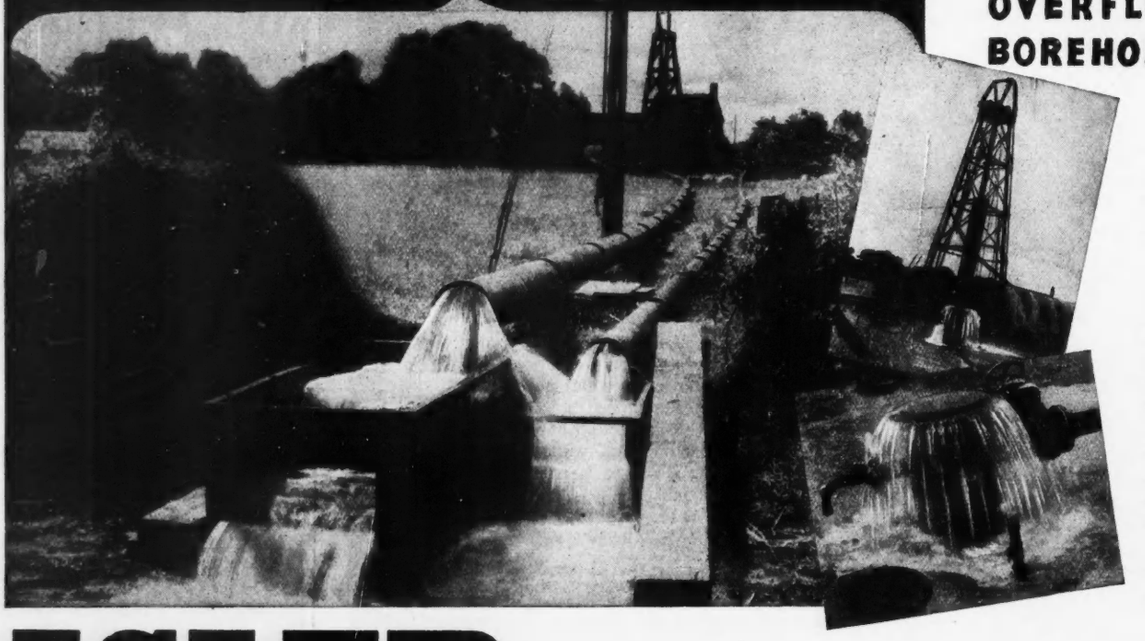

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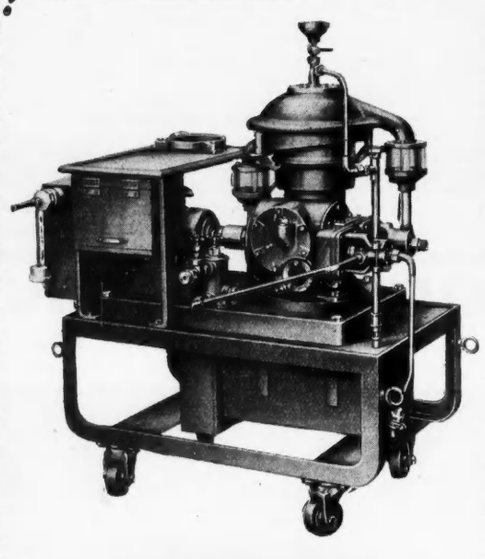
The Hopkinson Centrifuge for cutting oils is designed to provide a large dirt space in an inner cylinder to hold the heavy sediment from grinding oils (left). This improves the already high separating efficiency and prevents unbalance. The bowl can be cleaned quickly and easily by unskilled personnel.

*The illustration shows No. 2 Portable Centrifuge with 8 kW heater for the oil.*



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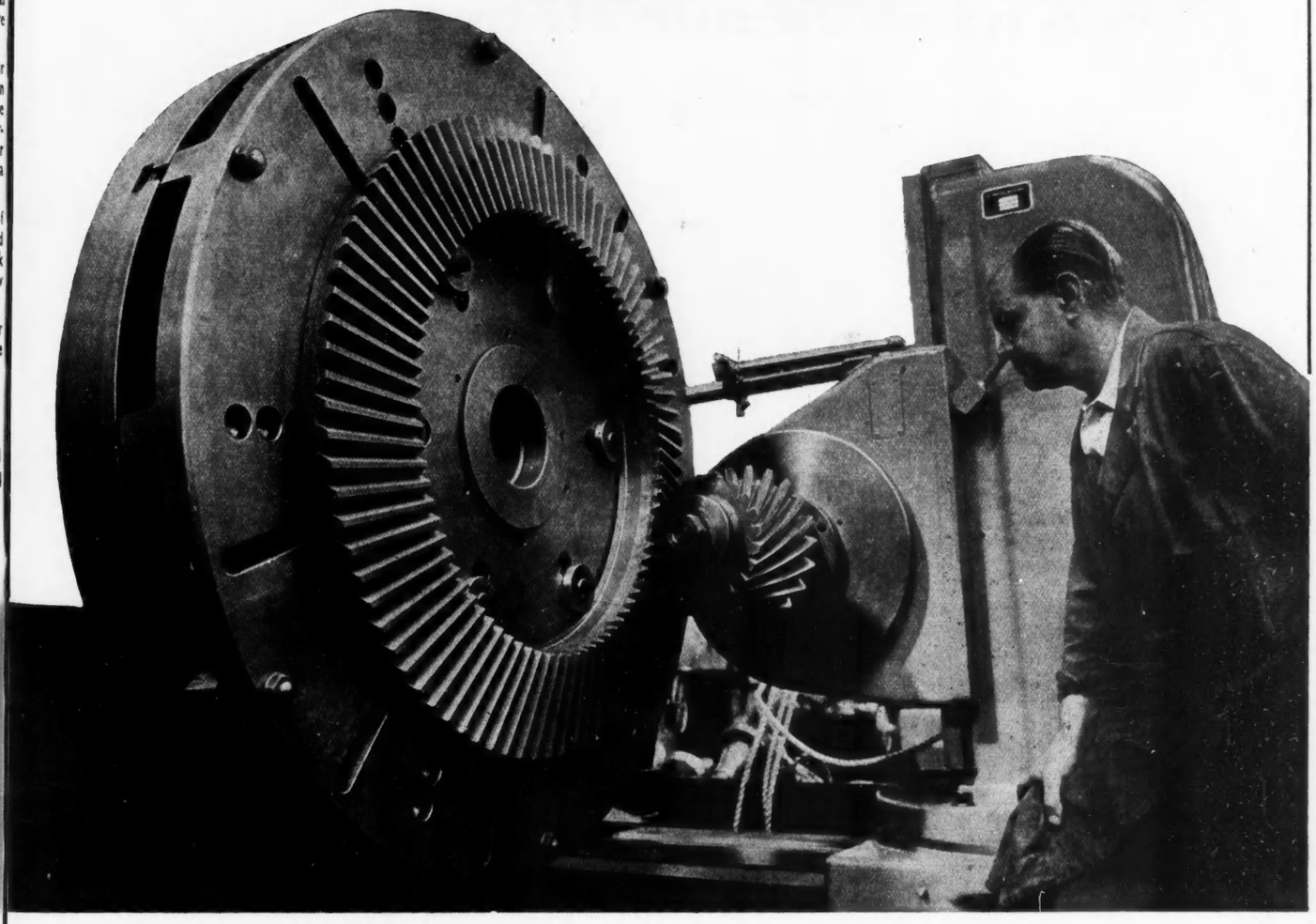

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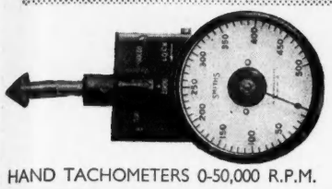
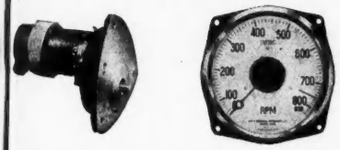


HAND TACHOMETERS 0-50,000 R.P.M.

NETIC TACHOMETERS 1½" TO 12" DIAMETER



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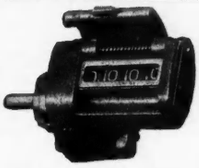
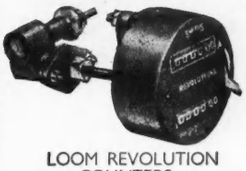


ENGINE SERVICE COUNTERS



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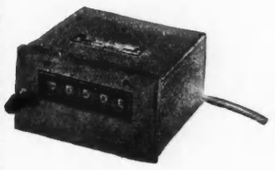

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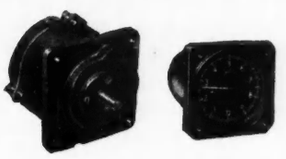

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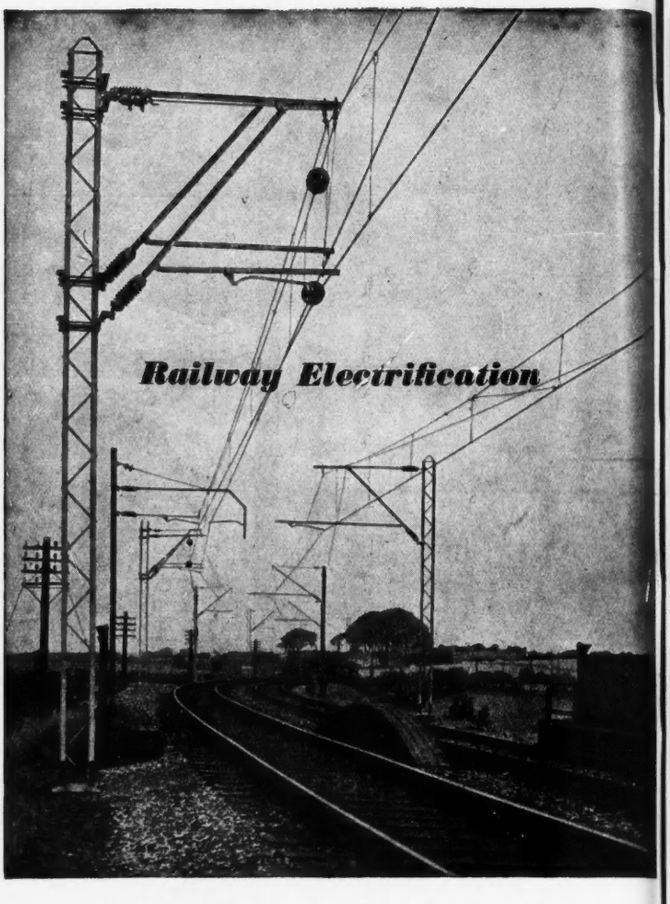


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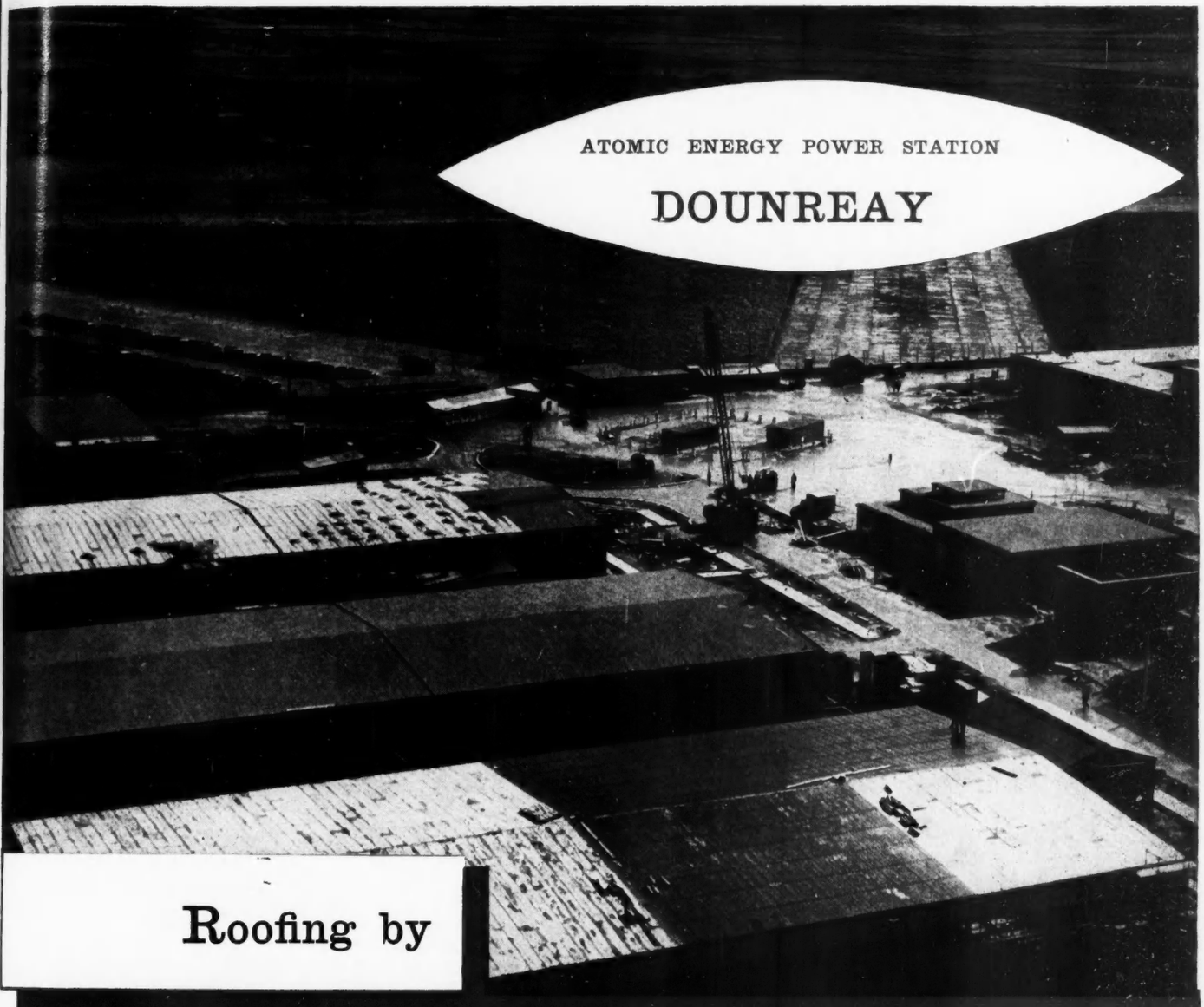


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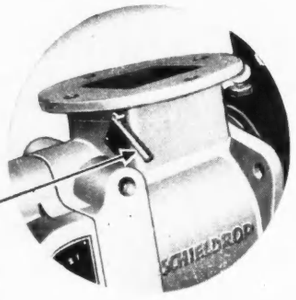


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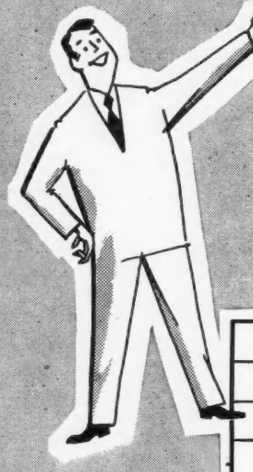

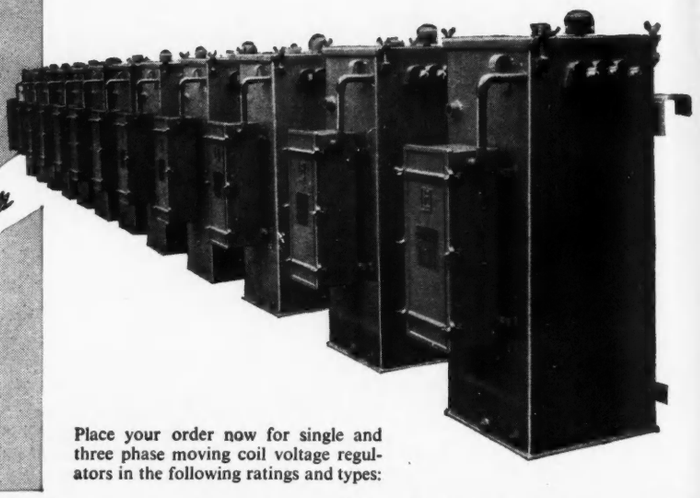

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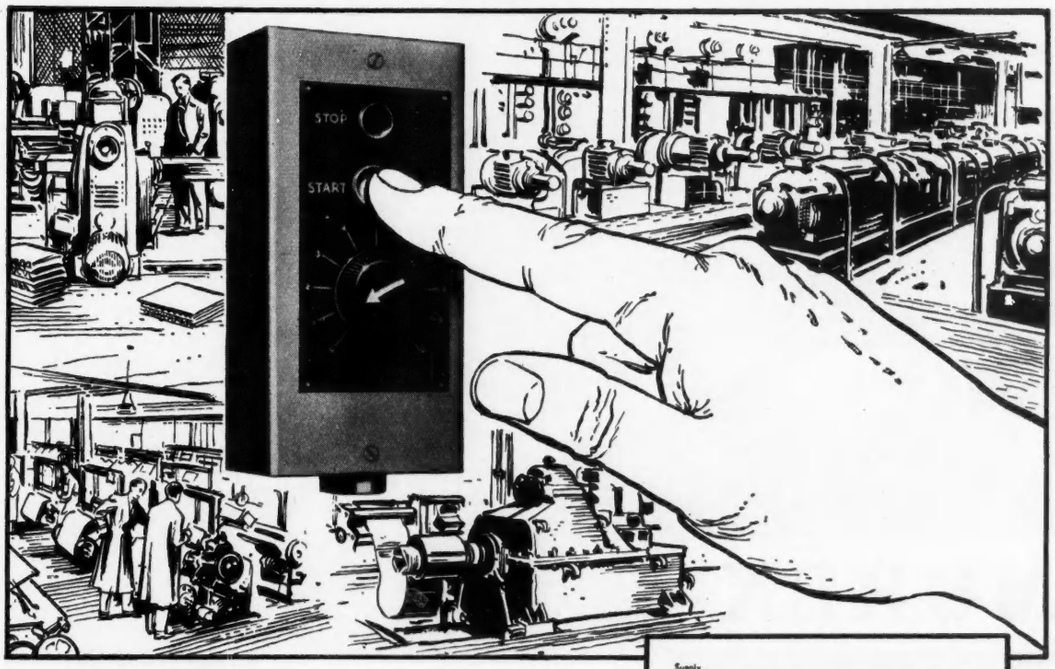


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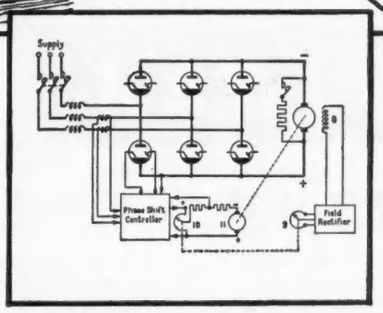


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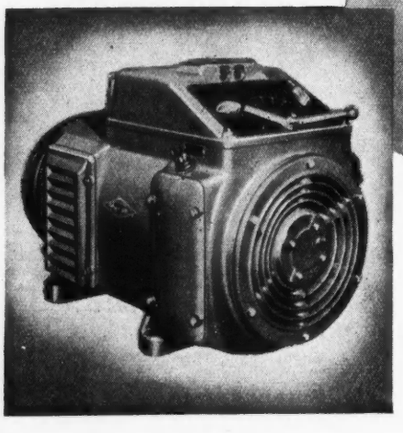

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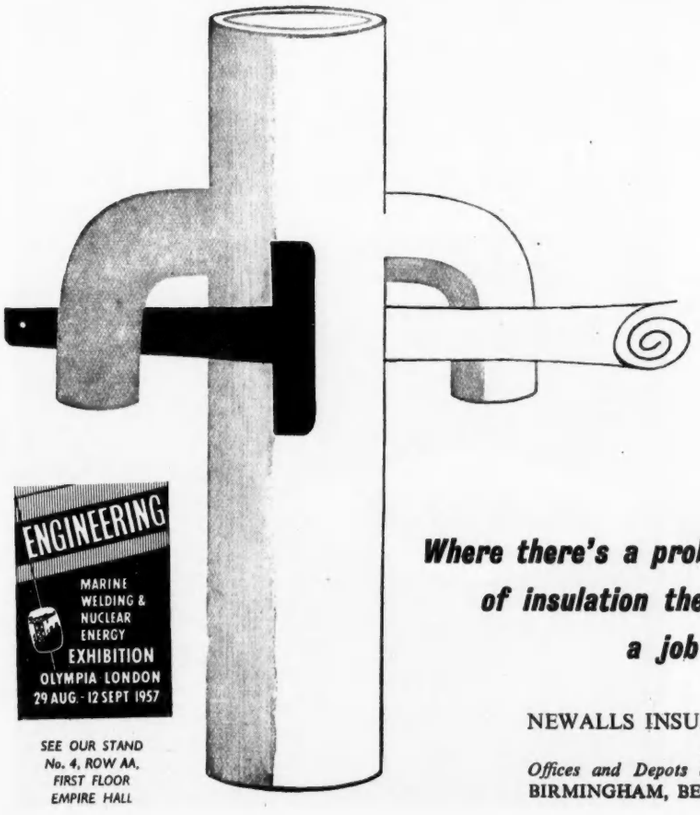

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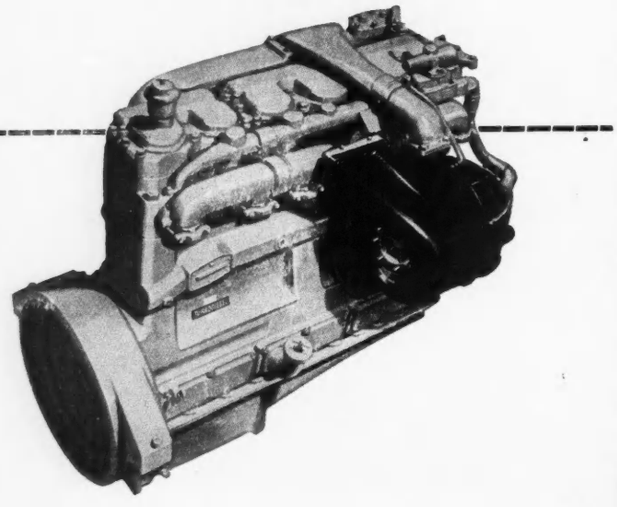

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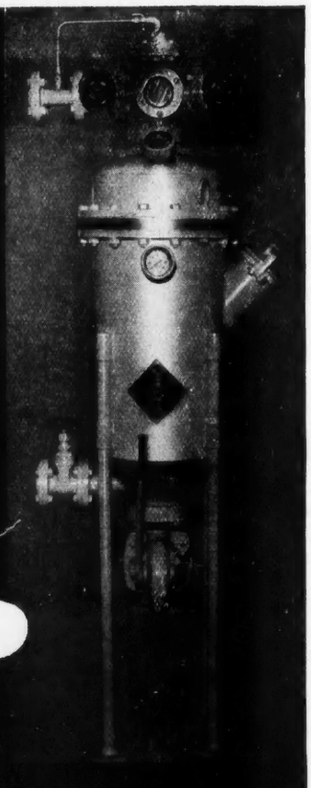

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*All sizes available*

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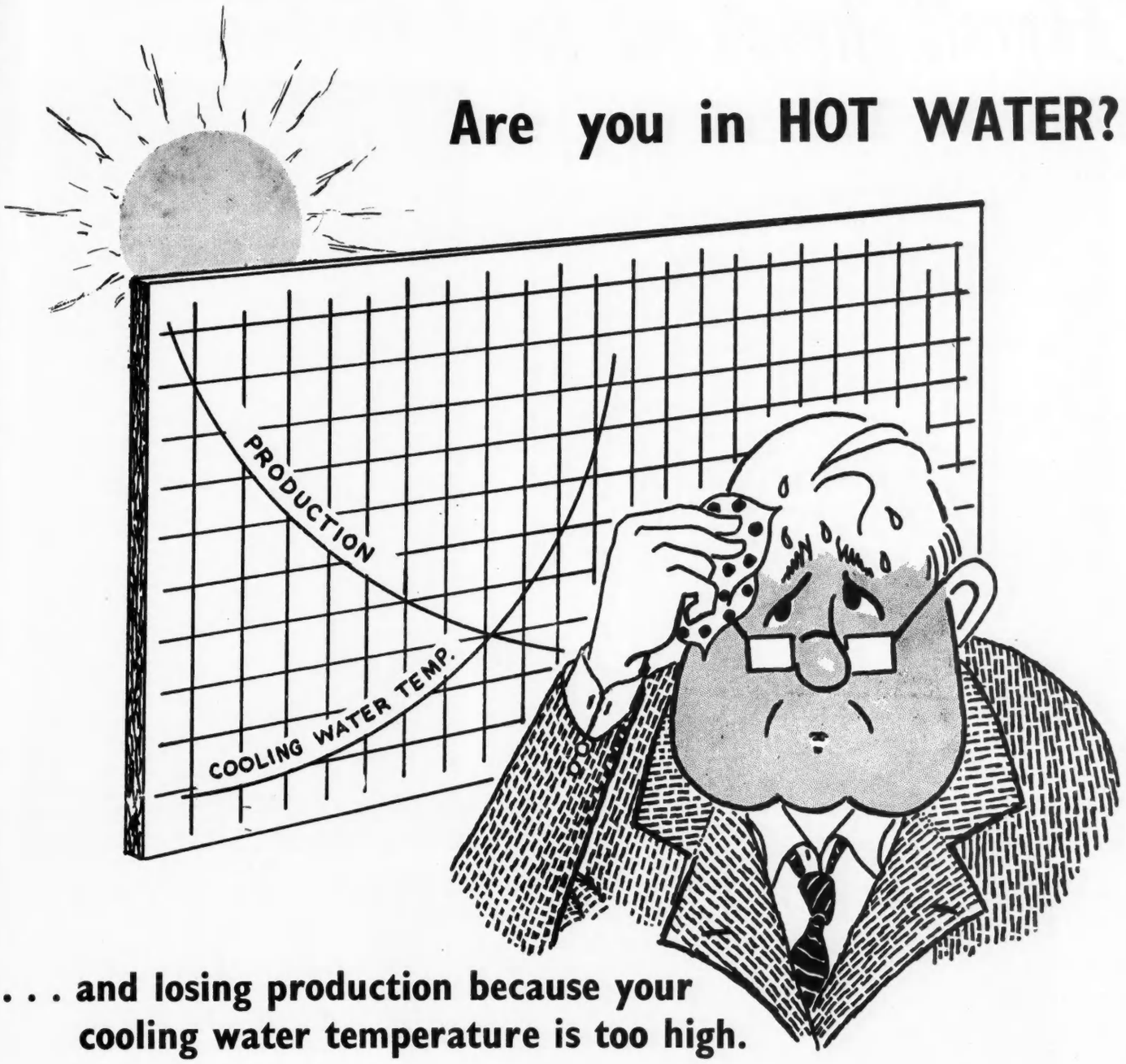


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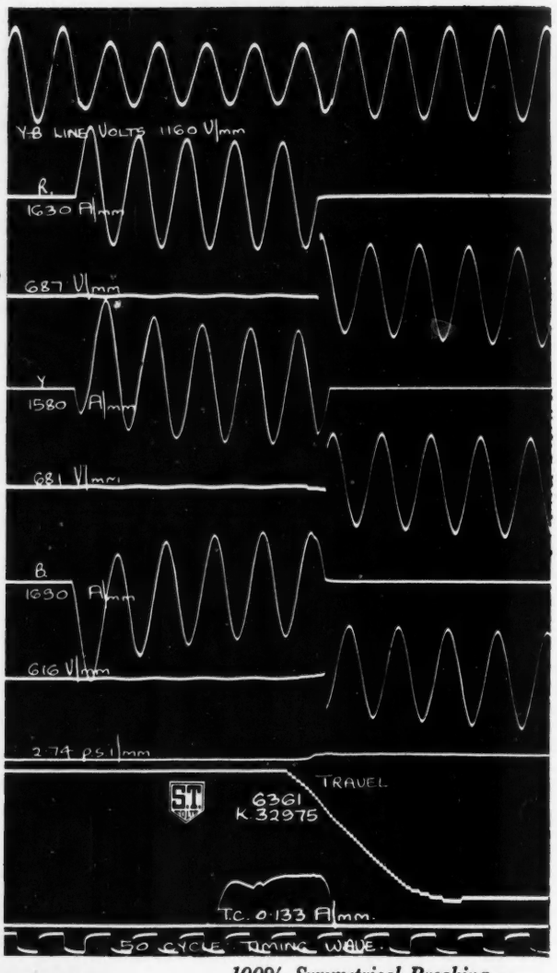
378—H

# *Here's proof of performance*

This oscillogram shows the performance of a typical Metrovick VH metal enclosed switchgear unit. Note particularly the absence of arcing on the first major peak. Switchgear of this type is ideally suited for the control of heavy industrial services or power station auxiliaries.




*100% Symmetrical Breaking—*
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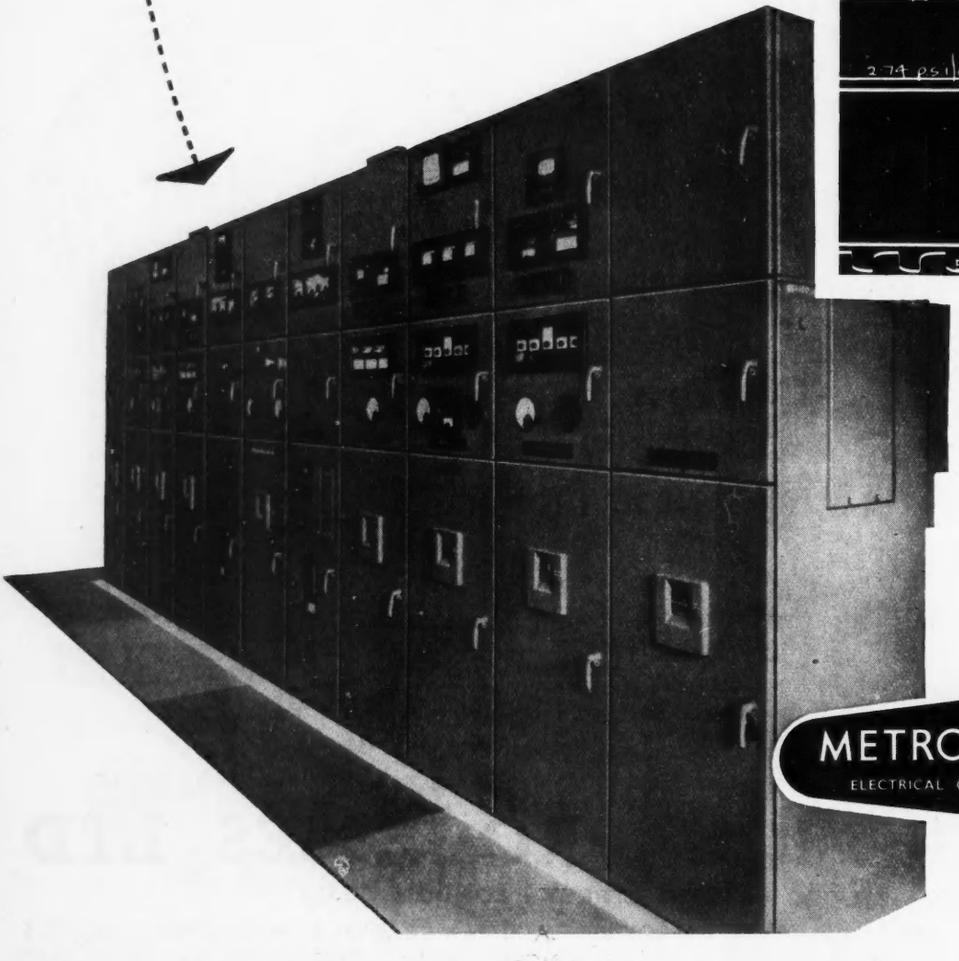
**150 MVA at 3.3 kV.**
**250 MVA at 6.6 kV.**
**350 MVA at 11 kV.**



*The illustration shows air insulated single busbar equipment, the same design can be compound filled single or double busbar type.*

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

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F/A708

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U.S. Matchless conveyor belting incorporates

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and is the product of the latest research to find belting with the greatest resistance to abrasion, tearing and gouging.

U.S. Matchless belting is in world-wide use conveying gold quartz, iron, copper, bauxite, granite, limestone, sand and gravel.

*U.S. Matchless is found throughout the world wherever trouble-free running is at a premium. Here Matchless belting is being vulcanised on site. This belt carries iron ore to the primary crushers of a large steel mill.*

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# *'These little jobs used to grow under our feet!'*

Yes, small jobs like floor patching can soon grow into major operations when they are not tackled in time. Trouble used to be that half the time went in mixing the concrete. Now the 'Mini-Giant' does all that—and can keep several men busy on the barrowing and laying. Mixes plaster and mortar, too, equally well. That means less time and labour wasted—fewer hold-ups in the factory because jobs are done more quickly. The 'Mini-Giant' soon saves its cost over and over again. Once you have it you will find that it is rarely idle (see letter below), and it needs no special skill to operate or look after. Write for Publication M.1 and you'll wonder why you ever let those little jobs grow under your feet!

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*Mixed capacity 2 cu. ft. Driven by economical 1 h.p. petrol engine or electric motor. On pneumatic tyres £92. On metal wheels £90. With brakes for fast towing £117. Immediate delivery on cash, hire purchase, or Credit Sale terms.*

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**"The 'Mini-Giant' has proved entirely satisfactory in all respects. It has been in almost continuous use since purchased and as it is so compact it has been possible to take it into any part of the factory where work was to be done."**

**it's a 'MINI-GIANT' you want!**

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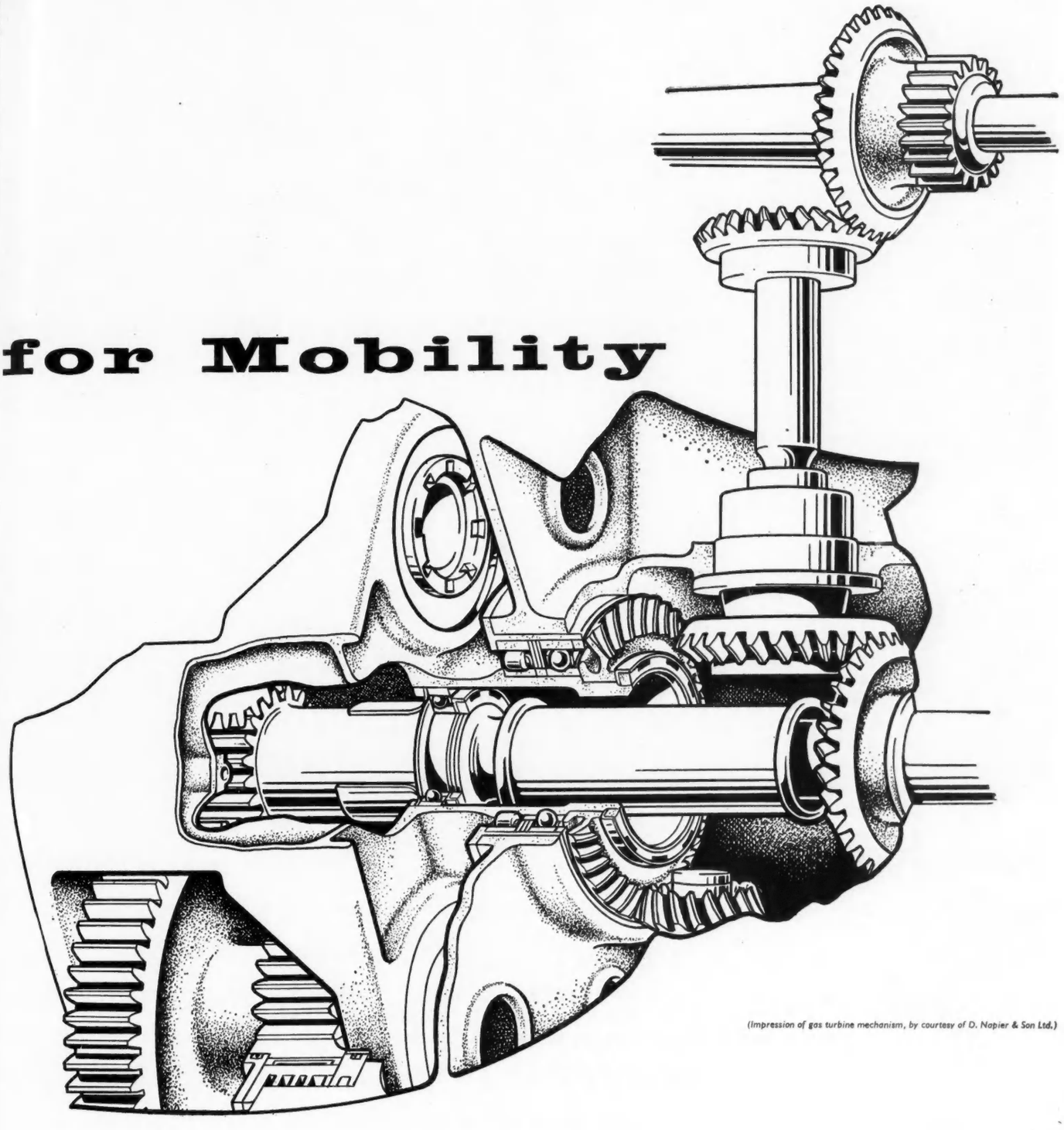
***The Gas Industry makes the best use of the nation's coal***

# for Mobility



(Impression of gas turbine mechanism, by courtesy of D. Napier & Son Ltd.)

Buses, trams, cars and aircraft would literally grind to a stop were it not for frictionless movement of their metal parts. Just as important as lubrication are carefully heat treated bearing surfaces. Town gas of known declared calorific value is the most effective fuel for all heat treatment processes.

*Issued by the Gas Council*

5A

**Jobs like this...** Putting together tank transporters is one of the bigger assemblies undertaken by Sankey of Wellington. At the other extreme, they produce washing machines by the thousand. In between; railway equipment, agricultural implements, steel furniture – anything, in fact, that calls for assembly operations on a big scale, whether in size, quantity or both. Sankey of Wellington are specialists in the shaping to close tolerances of metals in sheet, strip or plate. They are the largest producers of vehicle wheels in Europe, and their chassis frames, panels and similar components are found on British road vehicles throughout the world. In matters of pressing, welding, precision machining and large-scale assembly work of all kinds they are *the* experts. And the bigger the job the better they like it.

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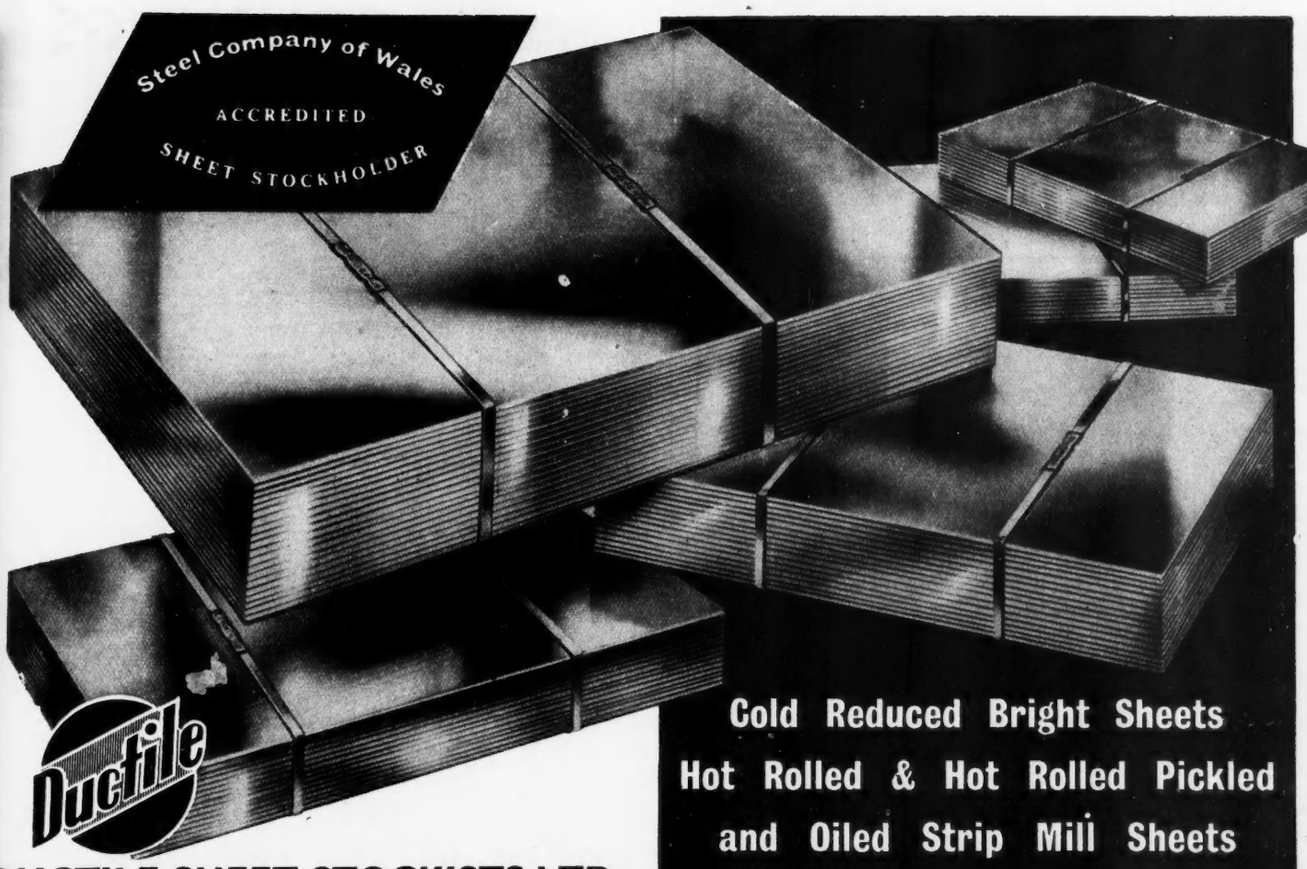


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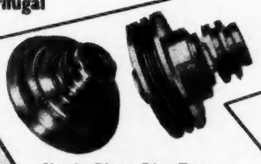
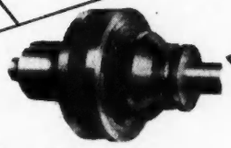

Single-Plate Disc Type Friction Clutch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Power Take-Off Unit

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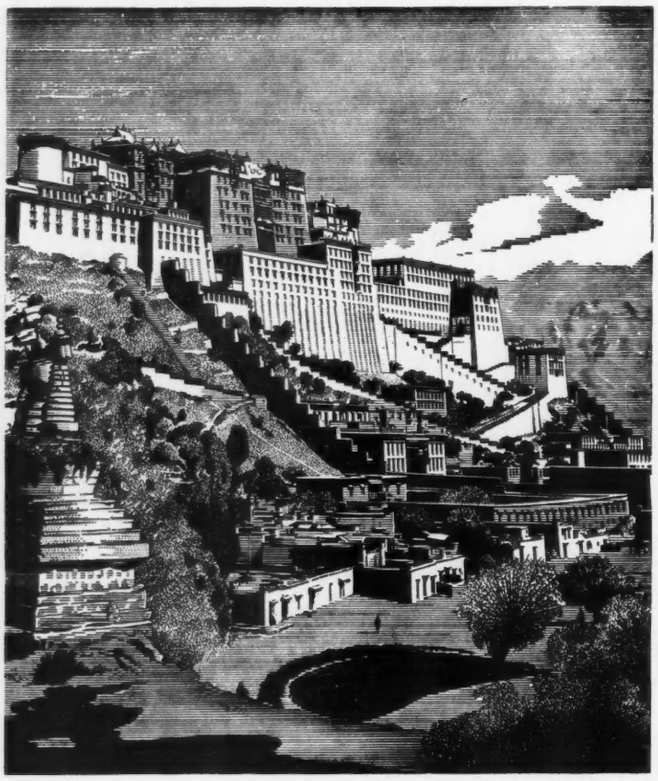
A16

## THE DALAI LAMA'S PALACE, TIBET



Wonders of the World

INSPIRED by the fifth Dalai Lama, the construction of this imposing palace at Lhasa was commenced in the seventeenth century. The Dalai Lama died before it was completed and his death was concealed from the populace by the regent for some sixteen years. Surmounting the palace are golden-roofed shrines of deceased Dalai Lamas. Thousands of pilgrims still bring gifts to the present ruler and the palace is said to store rich treasure.

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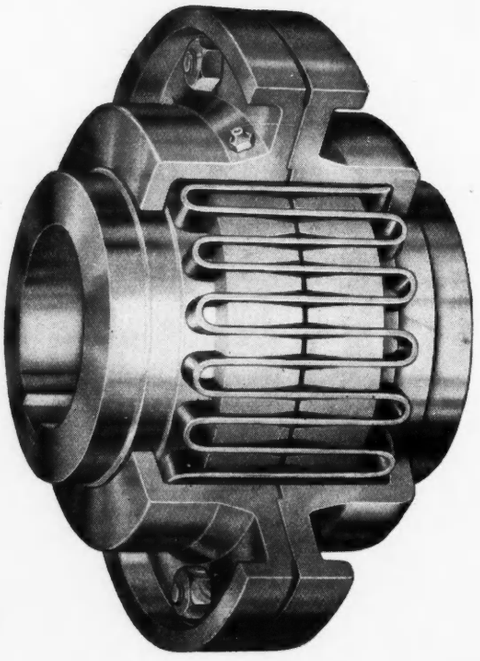

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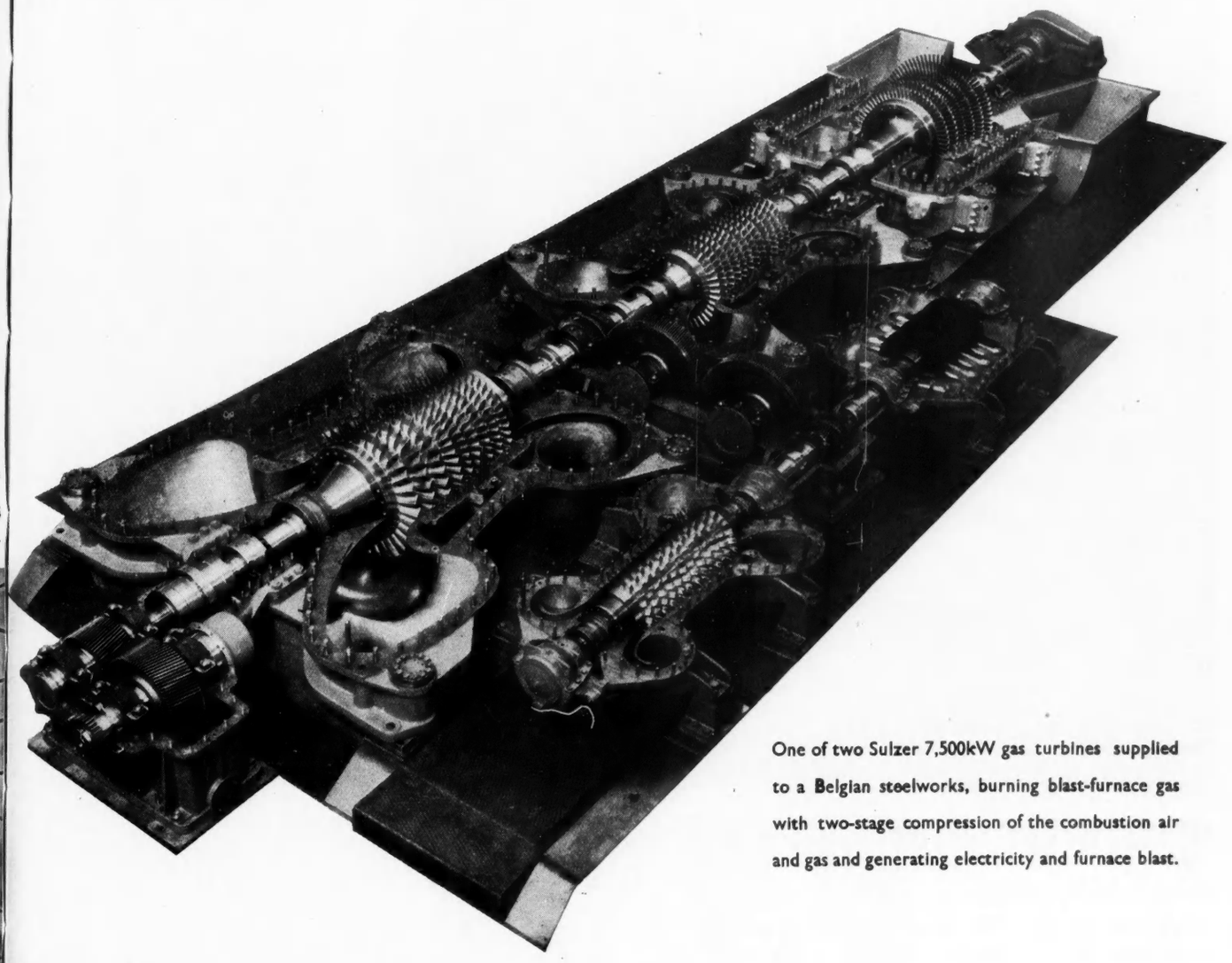

One of two Sulzer 7,500kW gas turbines supplied to a Belgian steelworks, burning blast-furnace gas with two-stage compression of the combustion air and gas and generating electricity and furnace blast.

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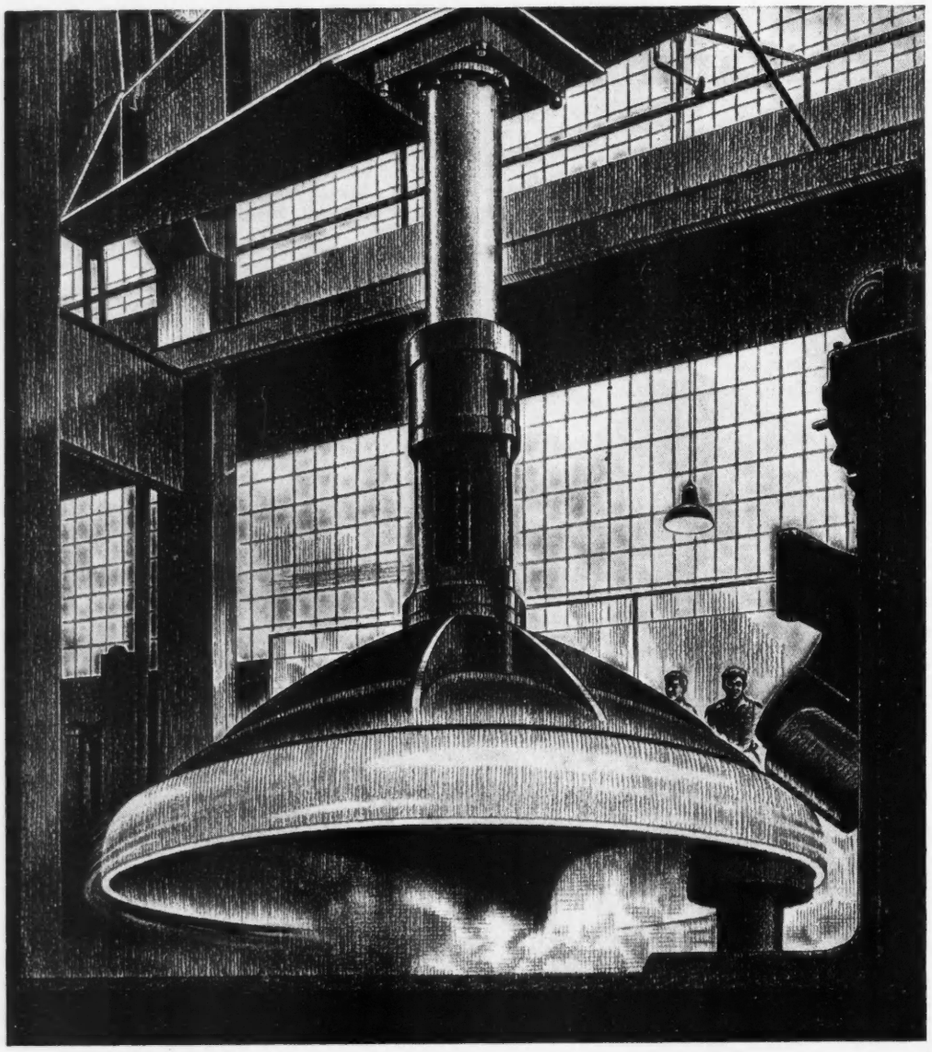
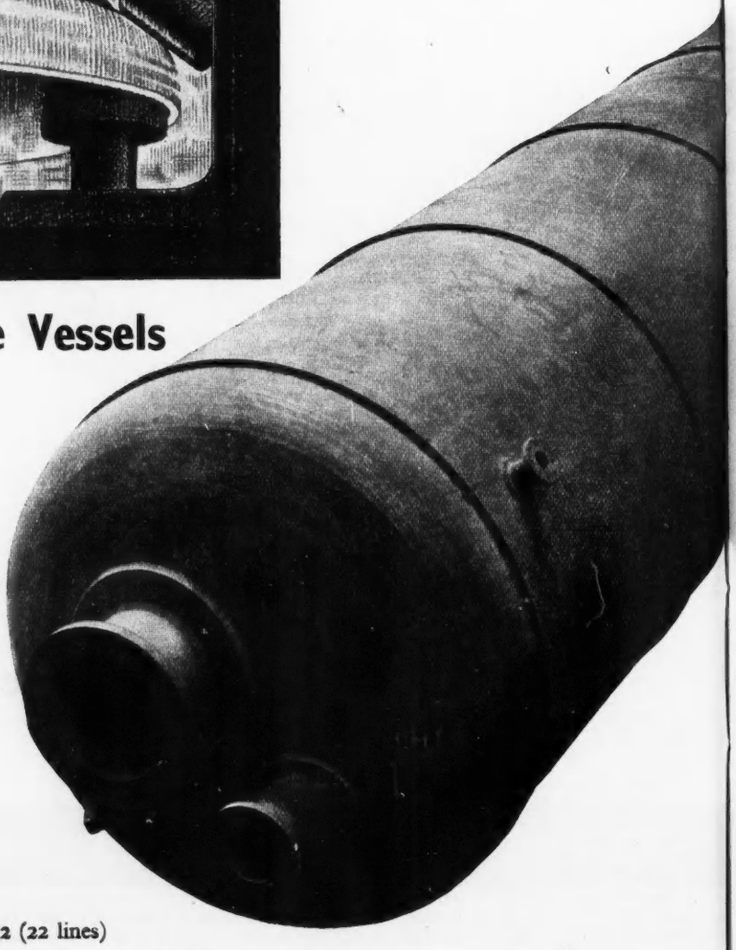
The design and production of Pressure Vessels may be greatly facilitated by using dished and flanged ends specified by Harveys on the Rotarpress. These combine semi-ellipsoidal form with large knuckle radius. A substantial reduction in plate thickness can be effected, and in most cases tool costs are eliminated.





## 'Rotarprest' Ends for Pressure Vessels

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*The storage tank illustrated is 10 ft. in diameter and 28 ft. long. Made in Timinium PA.99.5, the body is 7/16 in. thick and the ends ⅜ in. thick. Welding is by the Argonaut and Argon-arc methods. Weight empty is under 4 tons. Holding capacity is equivalent to 57 tons of water.*

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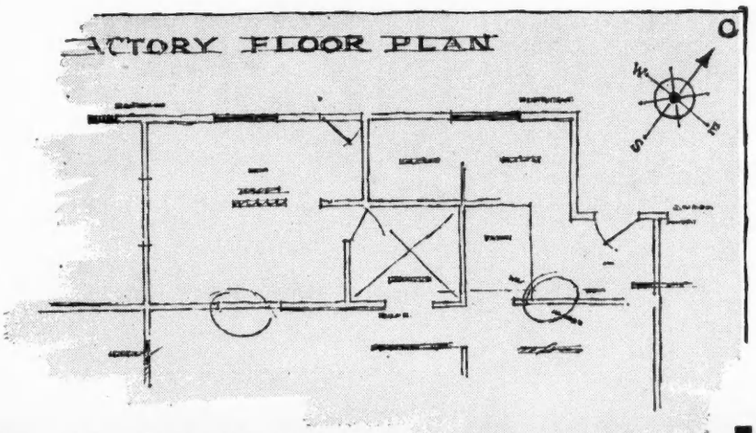


# I'm a spaceman myself!

but don't get me wrong. I won't be on the first moon rocket. I'm putting my factory space which cost good money to its proper use. In other words, I'm using it to house machinery and not throwing it away on big space-wasting drives. If you think three-dimensionally, like me, you'll use chain drives, and get another machine or two on that floor.

*This oil expellor installation for the treatment of oil bearing seeds and nuts is equipped with Renold Stock Chain Drives.*

# RENOLD chain drives conquer space problems in almost all applications

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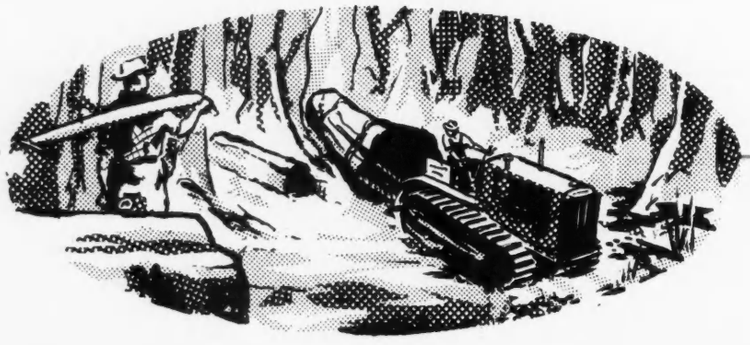

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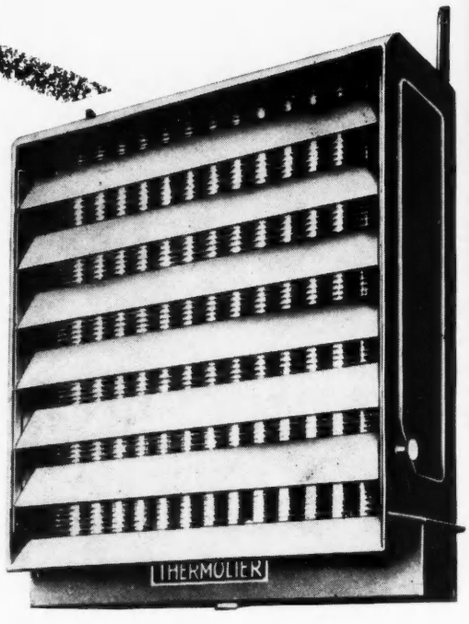
## *for CONTROLLED industrial heating*




Provides heat exactly where required. Warms the air at working level. Eliminates stagnation. Easily installed—minimum obstruction. Suitable for use with steam or accelerated hot water. Totally enclosed motors are exclusively employed. Standard A.C. motors; designed for 400/440 volts or 200/250 volts, 50 cycles. Standard D.C. motors; designed for 200/250 volts. Output capacity tables and all further particulars can be obtained from:–

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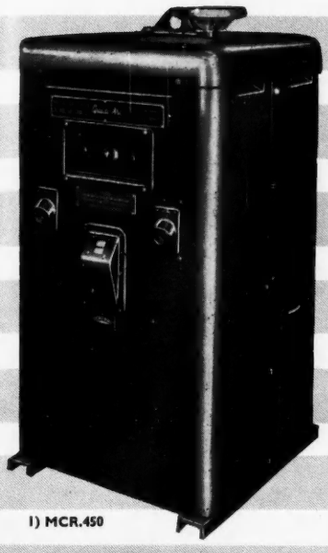
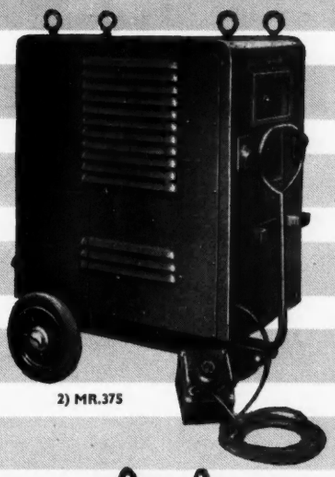
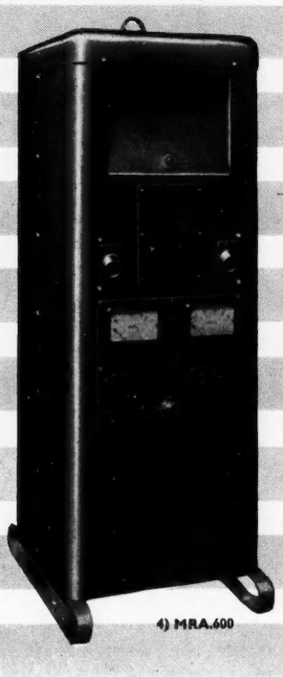


1) MCR.450



2) MR.375

3) MRS.425



4) MRA.600

5) MRA.1200

6) MCR.375

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**WHEN IT COMES TO WELDING**

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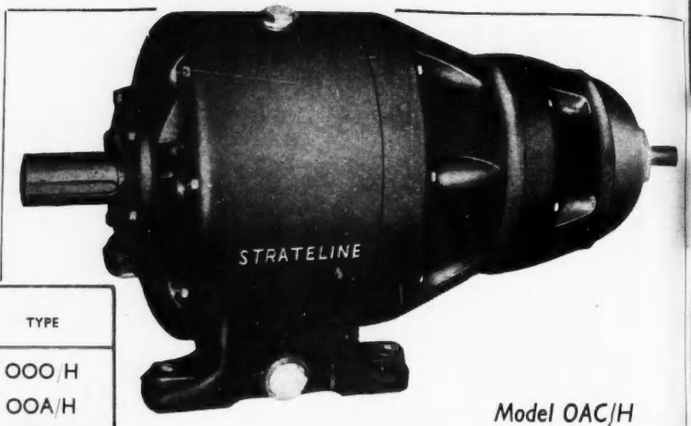


Model OAC/H

ALL DIMENSIONS IN INCHES

| MAX. TORQUE LBS. INS. | SHAFT CENTRE HEIGHTS | OVERALL HEIGHT | OVERALL WIDTH | OVERALL LENGTH | TYPE |
|---|---|---|---|---|---|
| 300 | 3 | 6¼ | 5¾ | 12 1/16 | OOO/H |
| 750 | 3⅜ | 7 7/16 | 6⅞ | 14 11/16 | OOA/H |
| 1500 | 4¼ | 8 11/16 | 8⅛ | 16 7/16 | OOB/H |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 6000 | 6⅛ | 14⅜ | 11¾ | 22⅝ | OAD/H |
| 12000 | 7¼ | 17 | 14 | 25 13/16 | OBE/H |
| 24000 | 8¾ | 20⅞ | 17 | 32⅝ | ACF/H |
| 48000 | 10¾ | 25½ | 21 | 39¼ | ADG/H |

**TRIPLE STAGE STRATELINE FIXED REDUCTION SPEED REDUCERS TORQUES FROM 300 LBS. INS. TO 48,000 LBS. INS.**

The "Hypocycloidal" gearing used makes possible ratios of up to 100 : 1 in each stage. The triple stage unit can be supplied in any ratio between 10,000 : 1 to 1,000,000 : 1 provided the final ratio is the product of three whole numbers in the single stages. For example 53 : 1 x 44 : 1 x 76 : 1 would give an overall ratio of 177,232 : 1. These reducers can be supplied as separate foot mounted units suitable for direct coupling, belt on chain drive, or complete with flange mounted motors. Study these overall dimensions against the available ratios and compare with all other forms of speed reduction.

Present your slow running problems to us for quick and efficient action.
**Four stage or more units are available giving unlimited ratios.**

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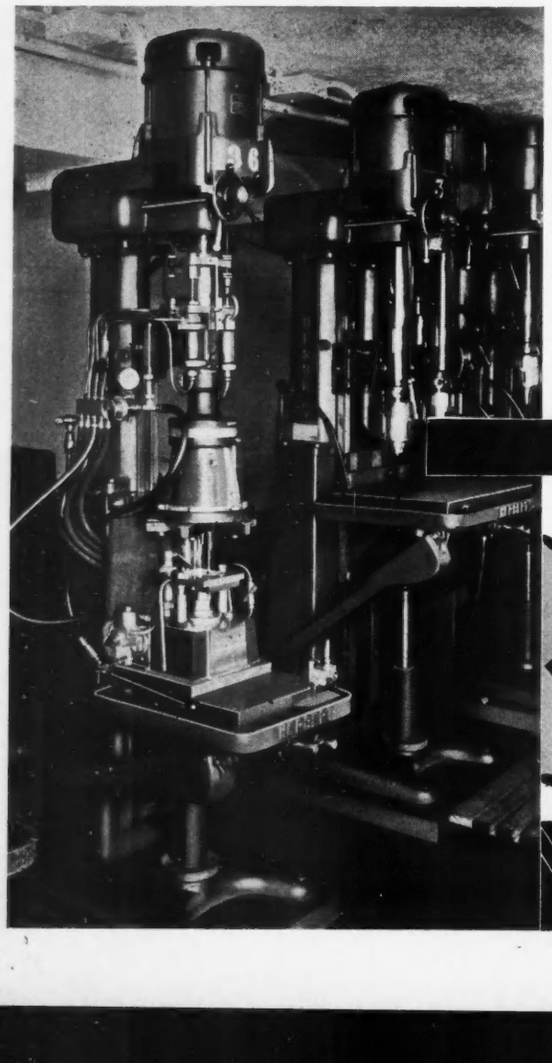
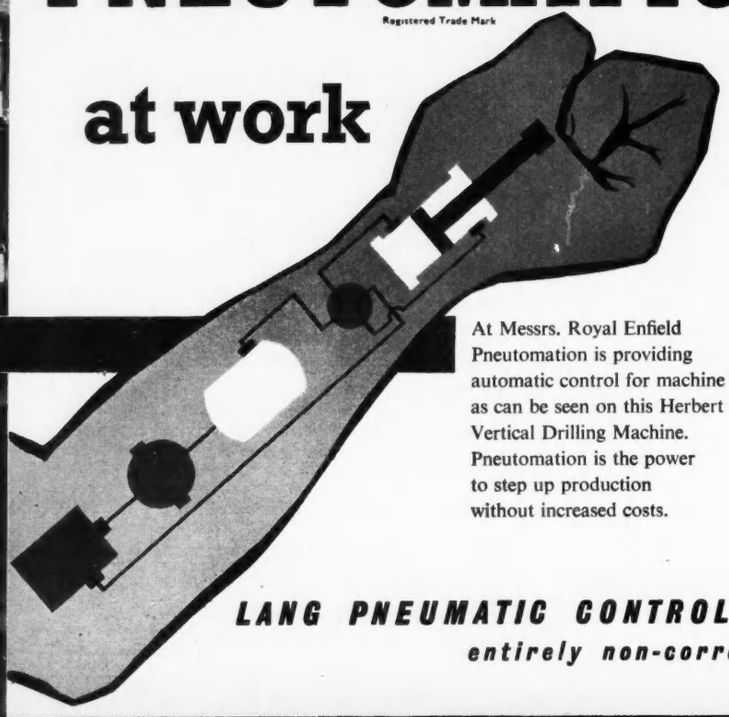


# PNEUTOMATION

Registered Trade Mark

## at work



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***entirely non-corrodible***

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## NEW PRINCIPLE CUTS RUNNING COSTS TO A MINIMUM

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(PATENT NOS. 720871 & 735673)

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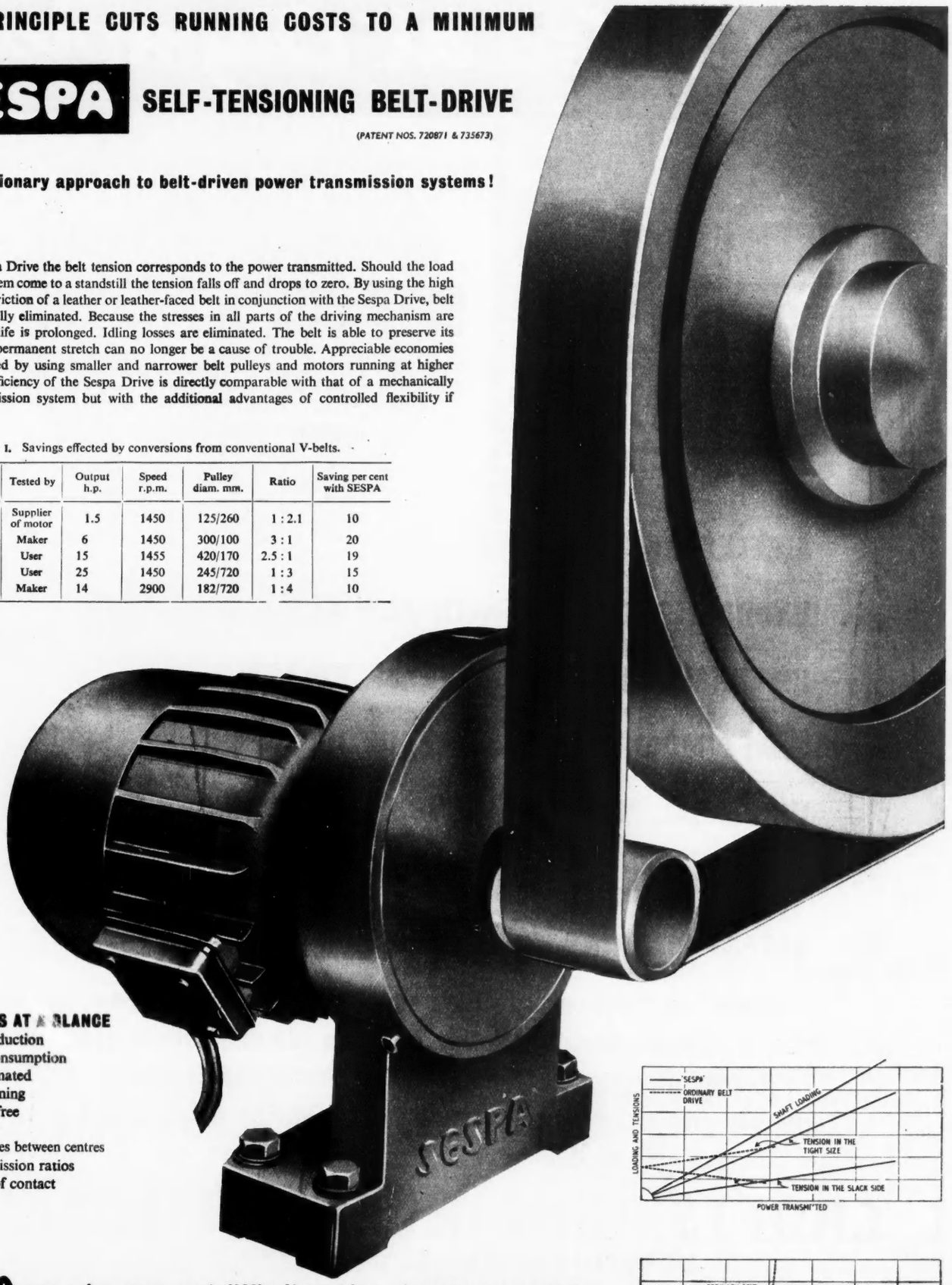
With the Sespa Drive the belt tension corresponds to the power transmitted. Should the load fall or the system come to a standstill the tension falls off and drops to zero. By using the high coefficient of friction of a leather or leather-faced belt in conjunction with the Sespa Drive, belt slip is practically eliminated. Because the stresses in all parts of the driving mechanism are lowered their life is prolonged. Idling losses are eliminated. The belt is able to preserve its elasticity and permanent stretch can no longer be a cause of trouble. Appreciable economies can be obtained by using smaller and narrower belt pulleys and motors running at higher speeds. The efficiency of the Sespa Drive is directly comparable with that of a mechanically locked transmission system but with the additional advantages of controlled flexibility if required.

TABLE I. Savings effected by conversions from conventional V-belts.

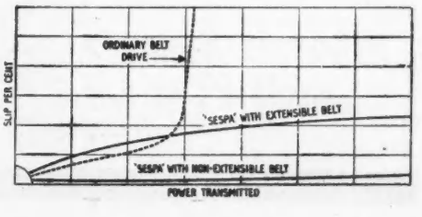
| Conditions Application | Tested by | Output h.p. | Speed r.p.m. | Pulley diam. mm. | Ratio | Saving per cent with SESPA |
|---|---|---|---|---|---|---|
| Loom | Supplier of motor | 1.5 | 1450 | 125/260 | 1 : 2.1 | 10 |
| Hammermill | Maker | 6 | 1450 | 300/100 | 3 : 1 | 20 |
| Fan | User | 15 | 1455 | 420/170 | 2.5 : 1 | 19 |
| Fan | User | 25 | 1450 | 245/720 | 1 : 3 | 15 |
| Compressor | Maker | 14 | 2900 | 182/720 | 1 : 4 | 10 |




**ADVANTAGES AT A GLANCE**

Increased production
Less power consumption
Belt slip eliminated
Smoother running
Maintenance free
Reduced wear
Shorter distances between centres
Larger transmission ratios
Small angles of contact

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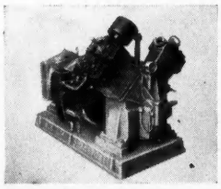

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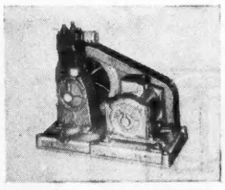

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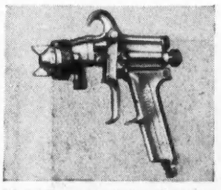

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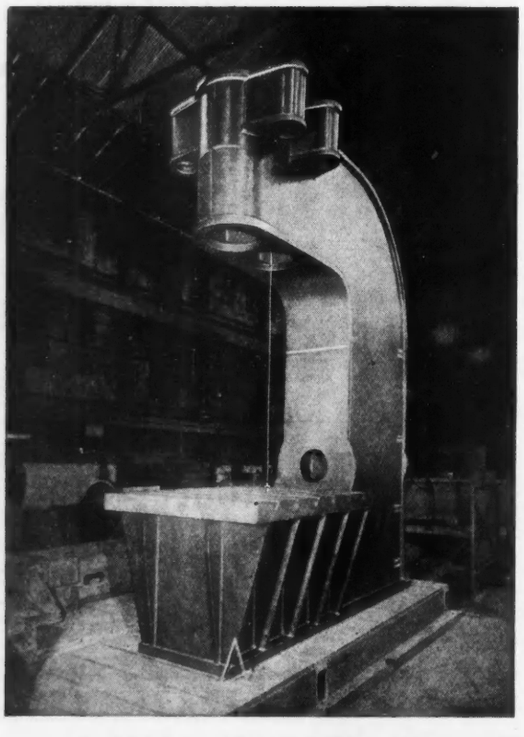

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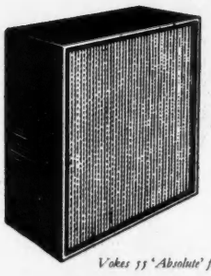
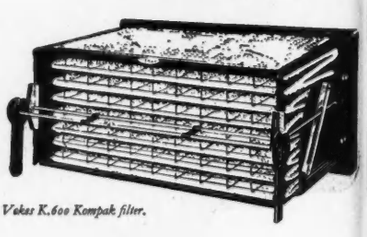


*Vokes 55 'Absolute' filter.*



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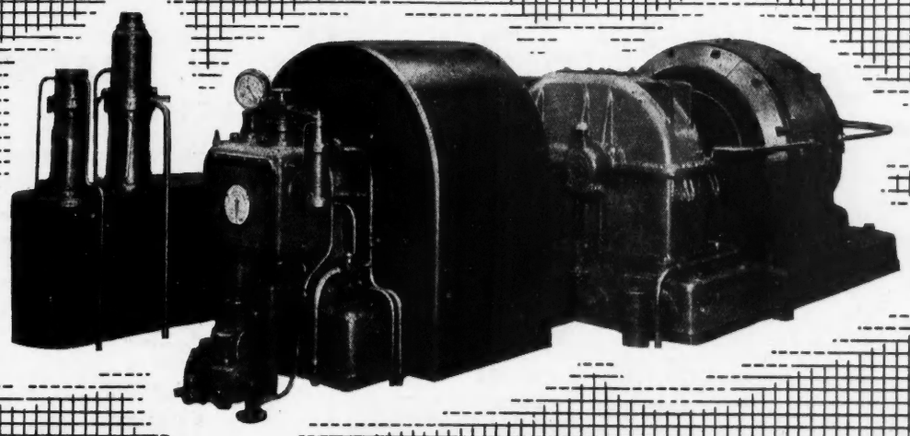

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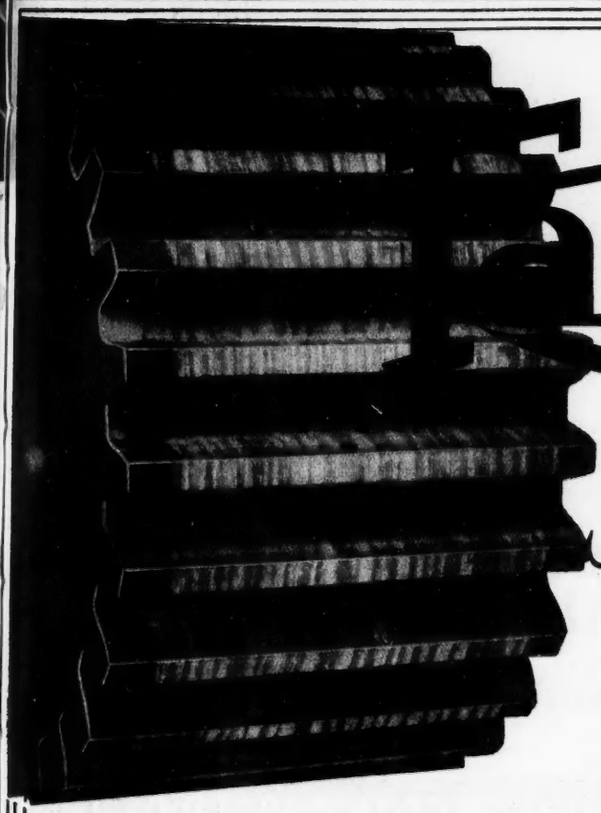

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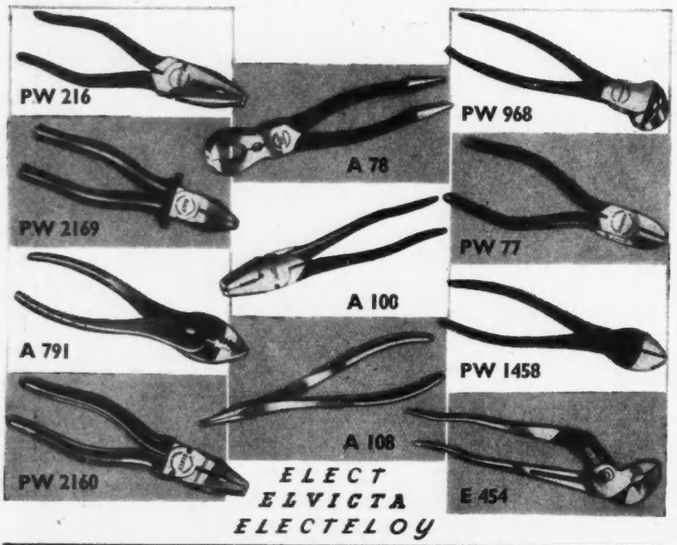


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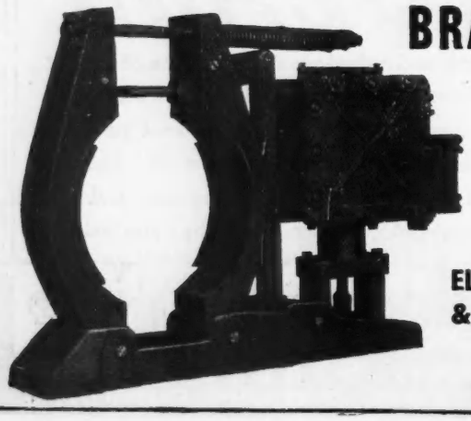

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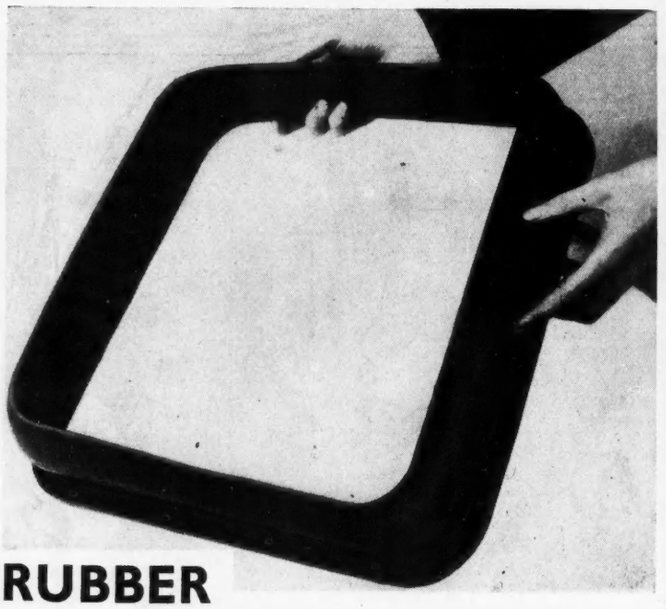

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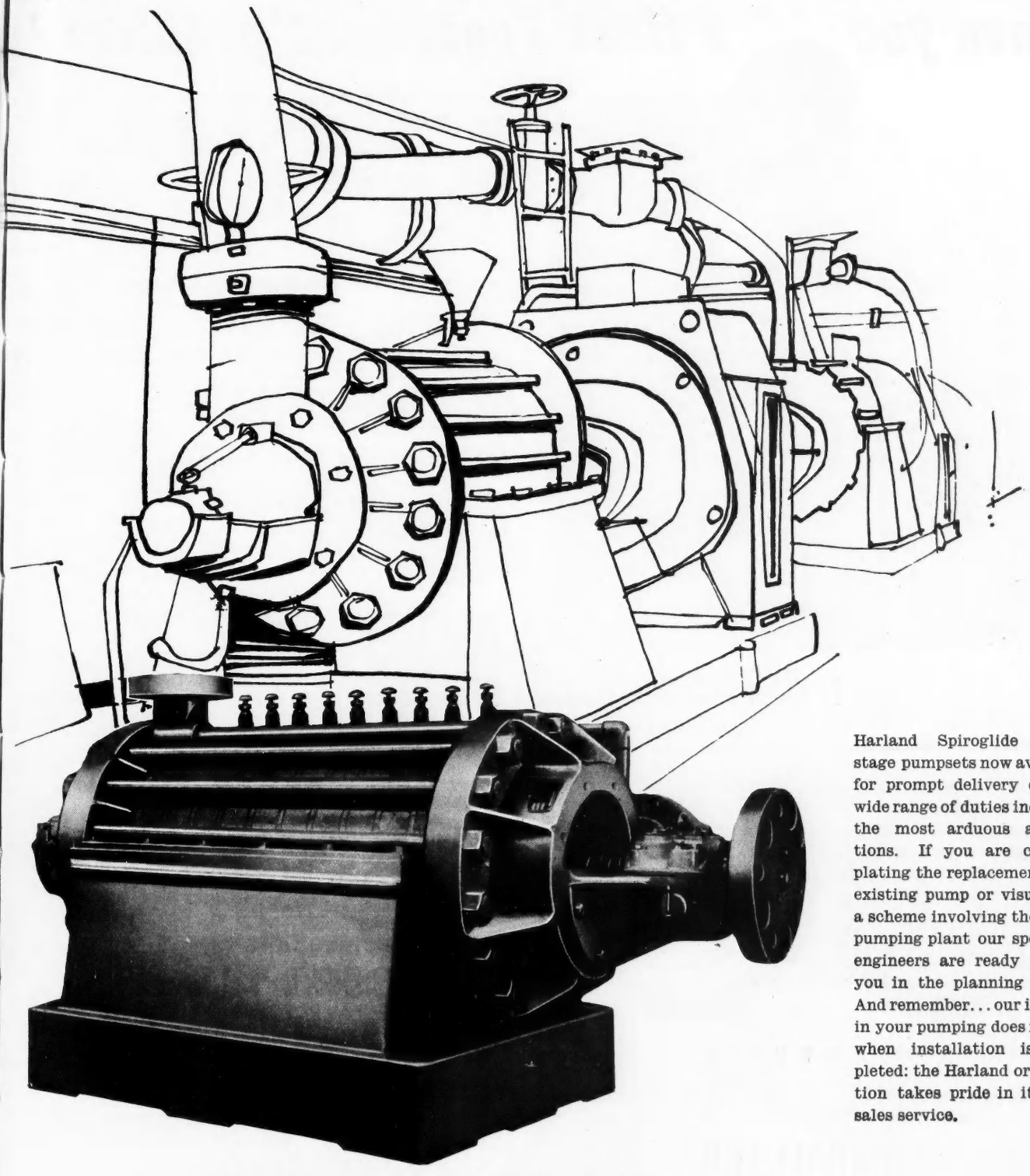

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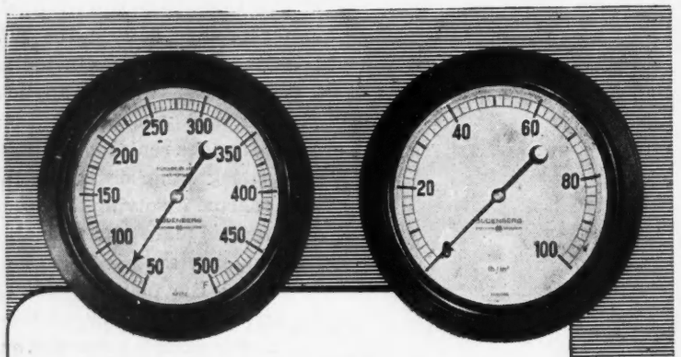

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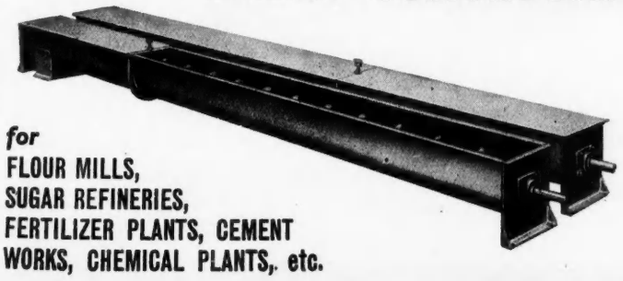

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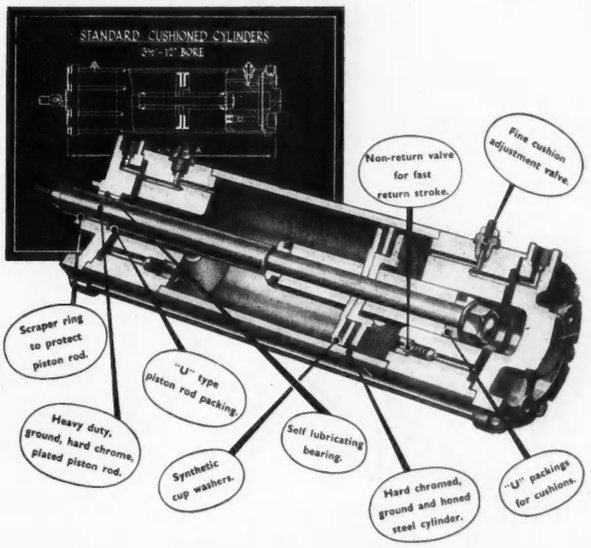
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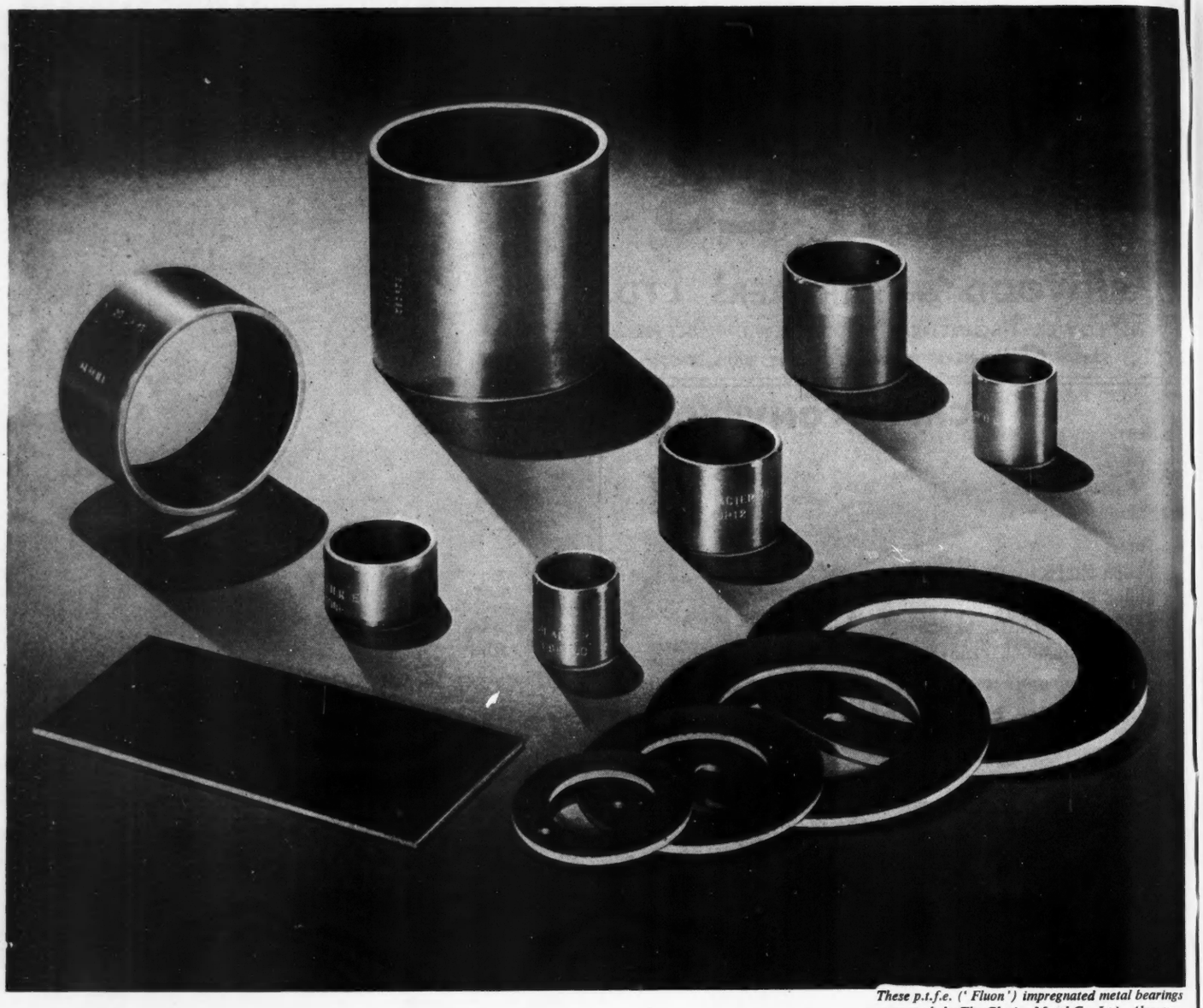

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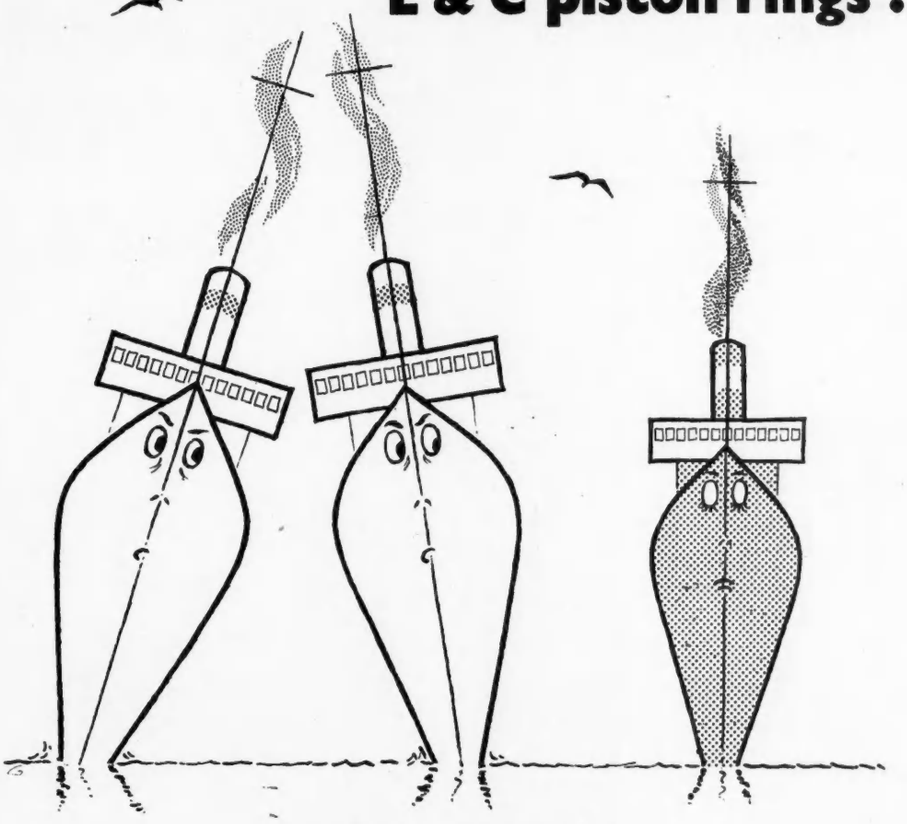

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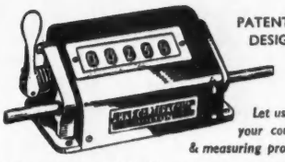

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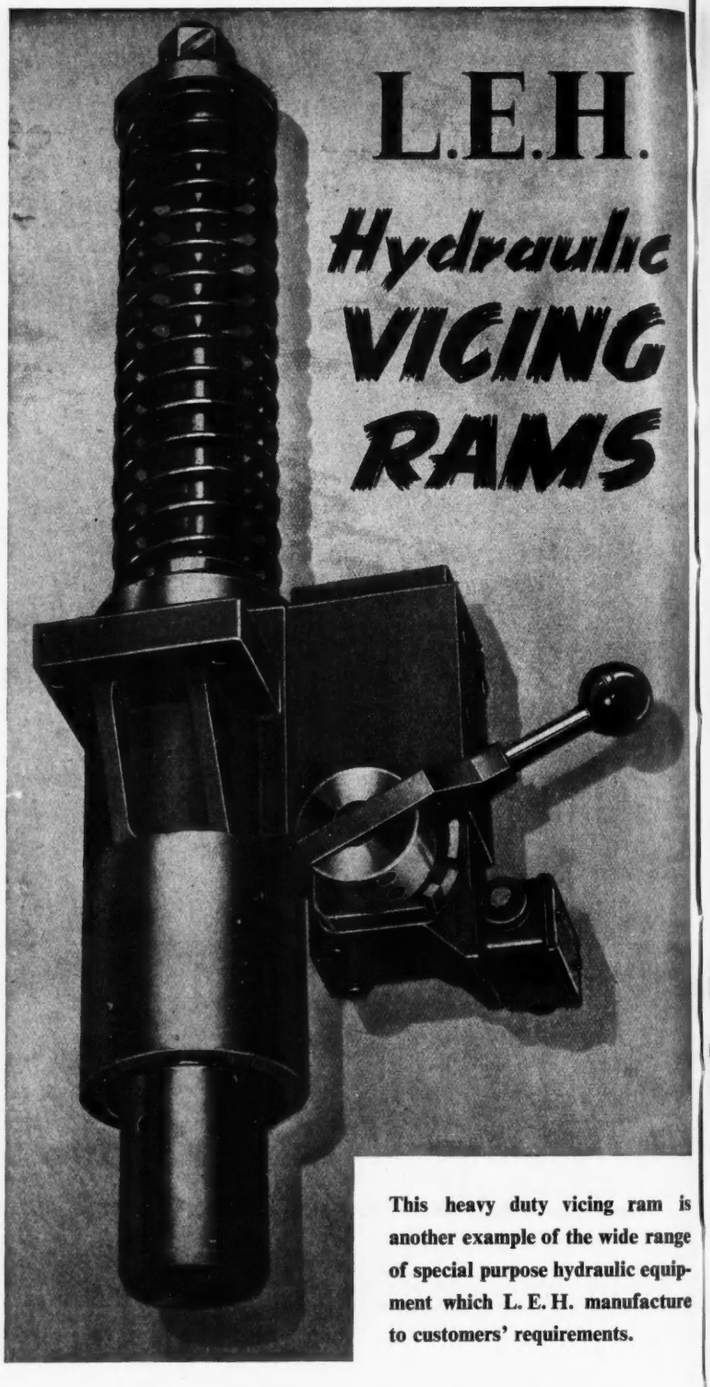

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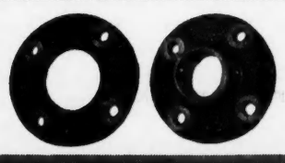

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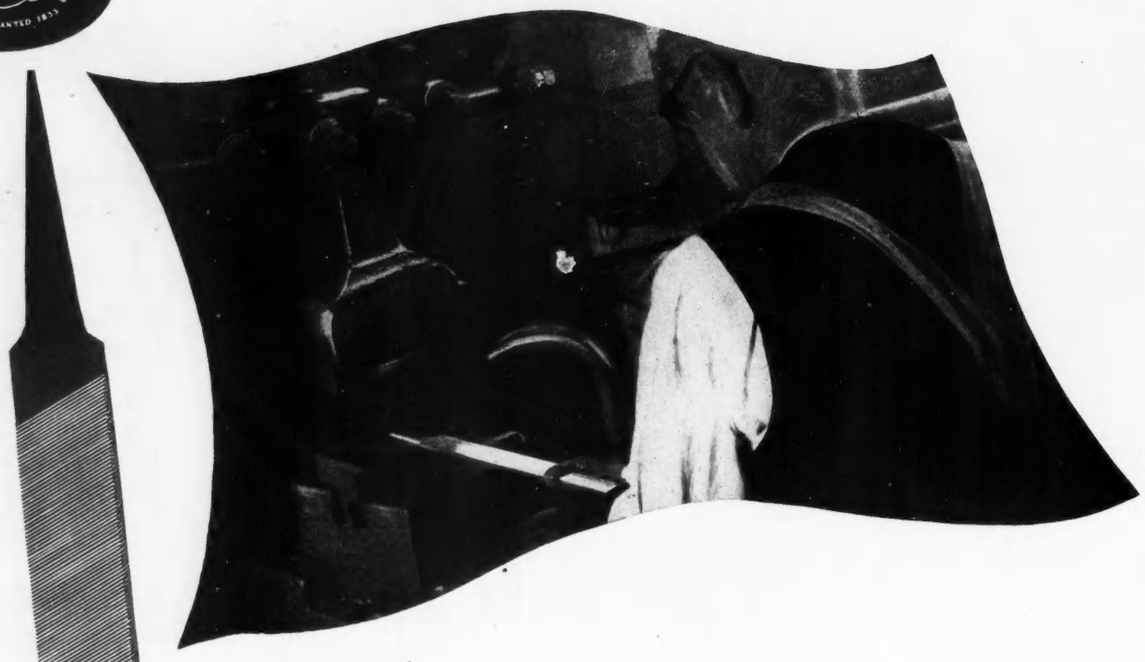

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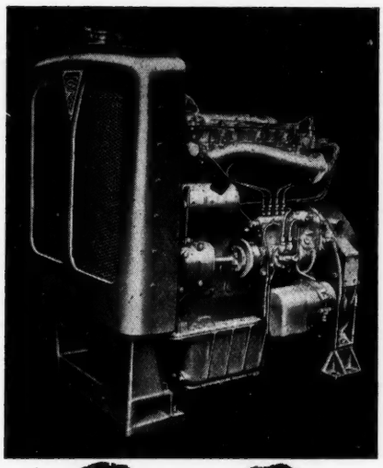

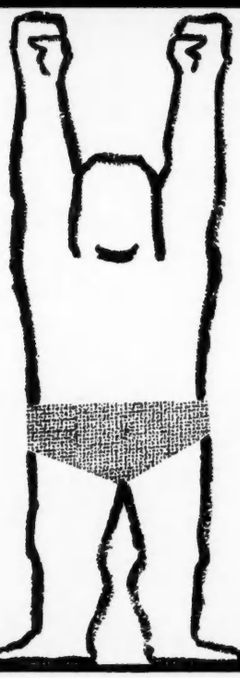

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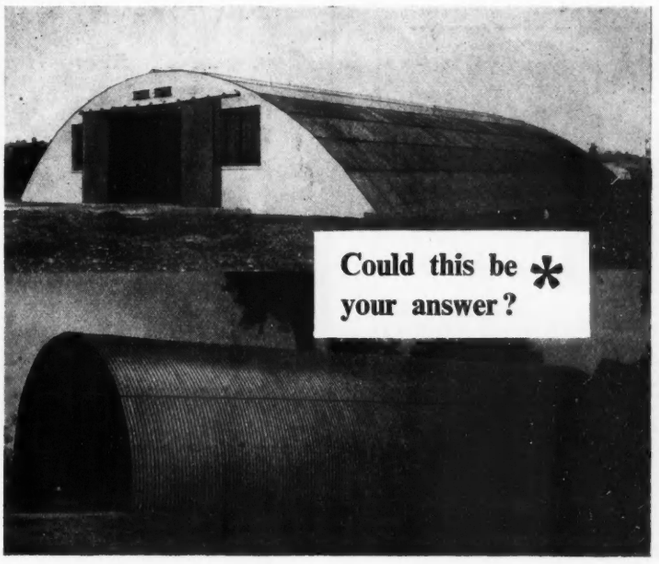


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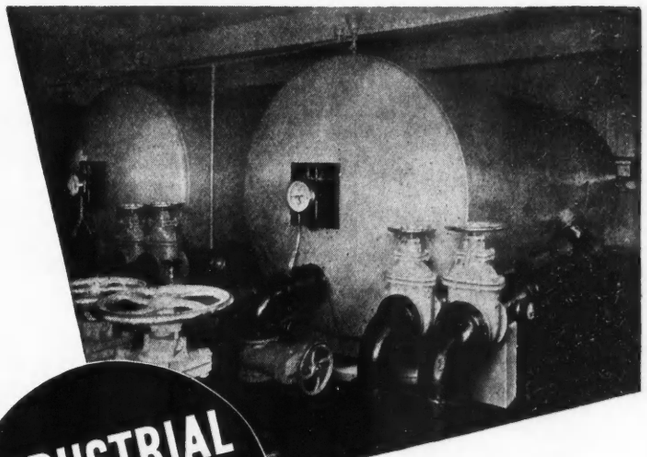

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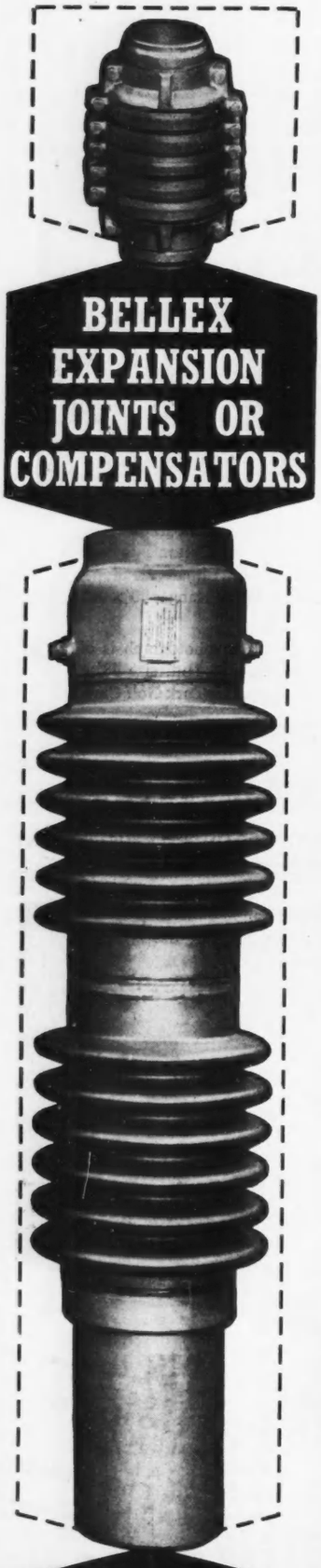

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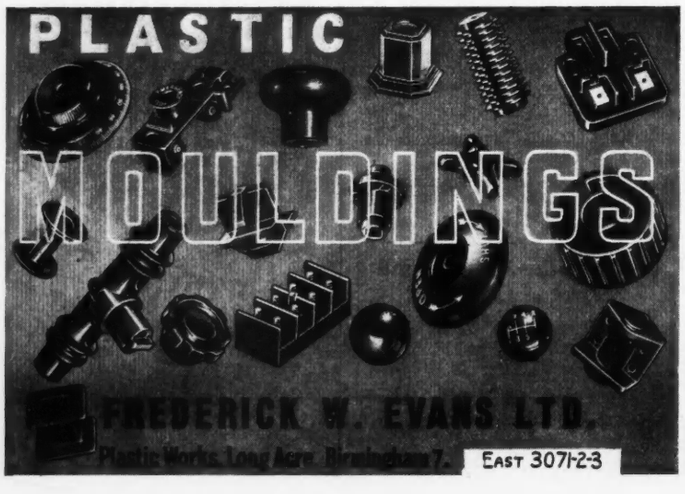


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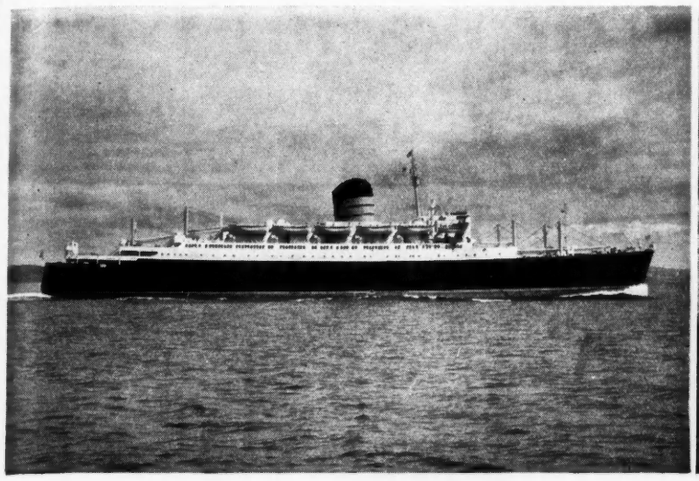

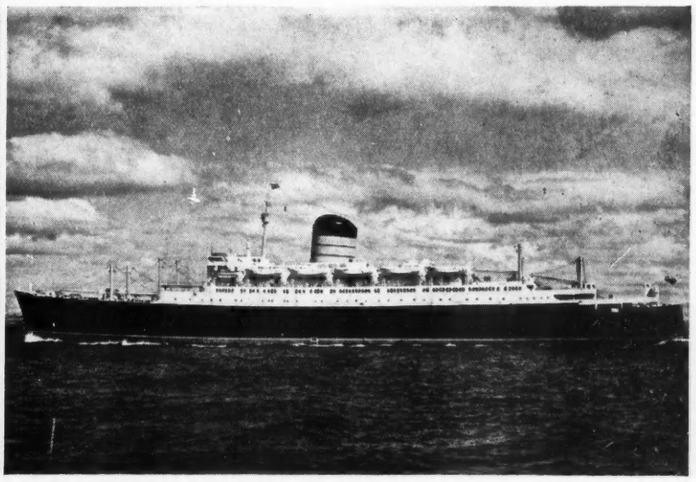

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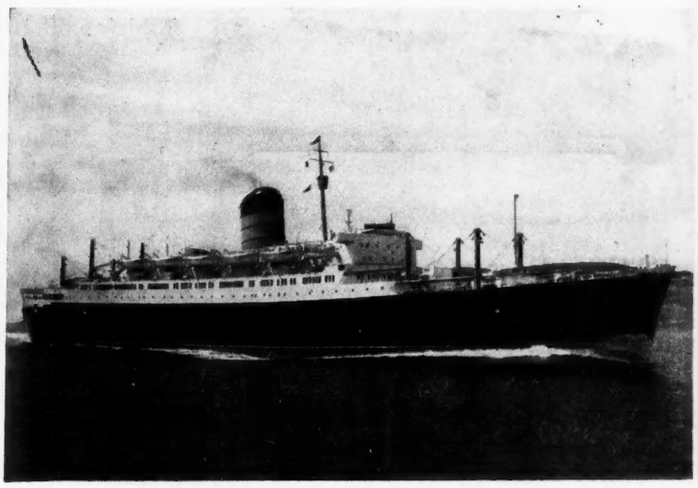

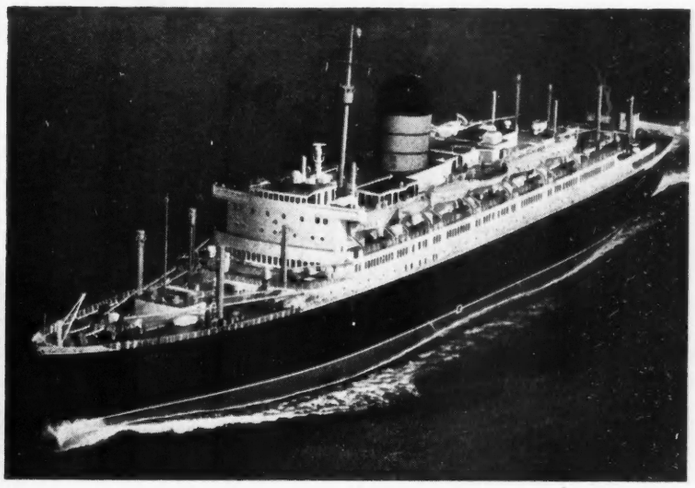

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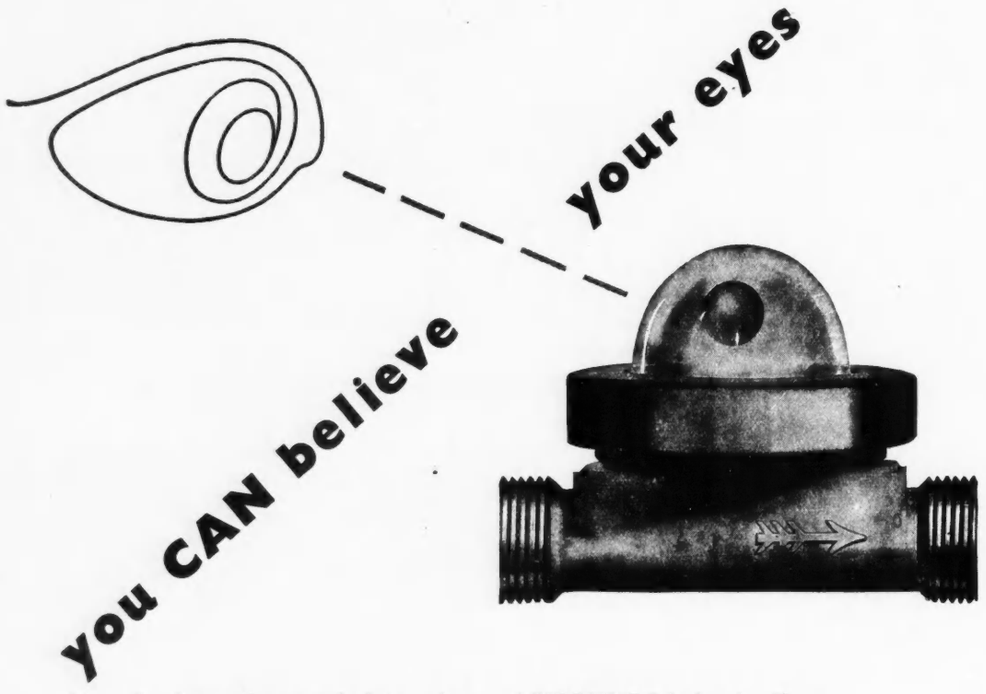


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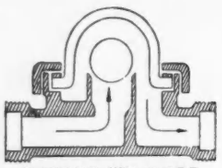

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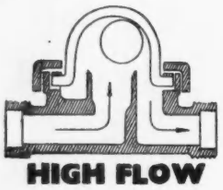

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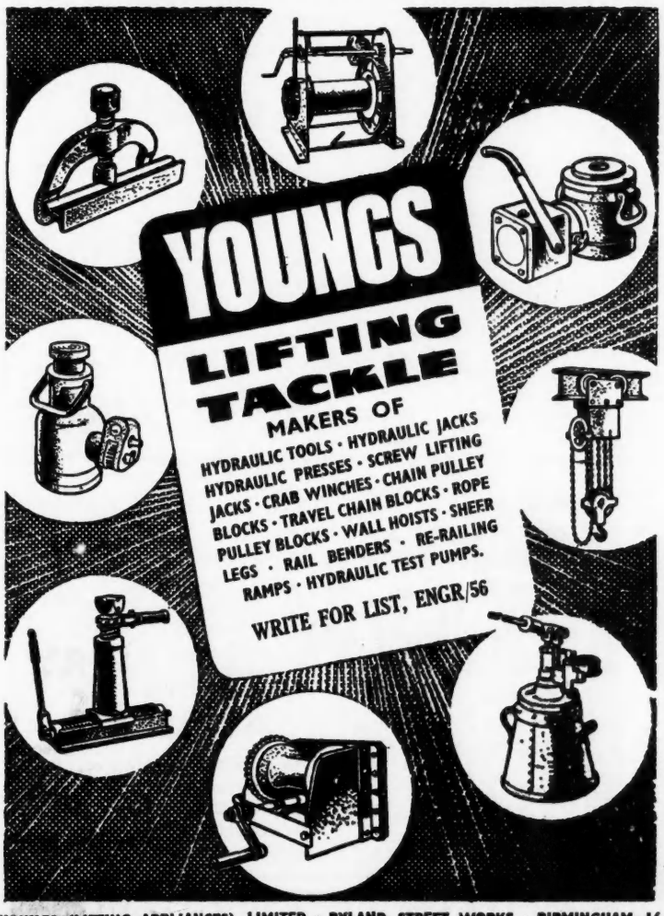
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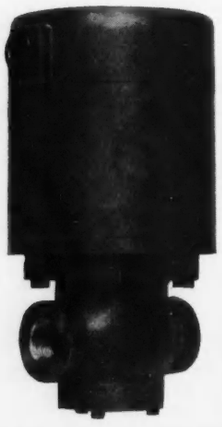

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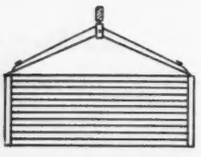

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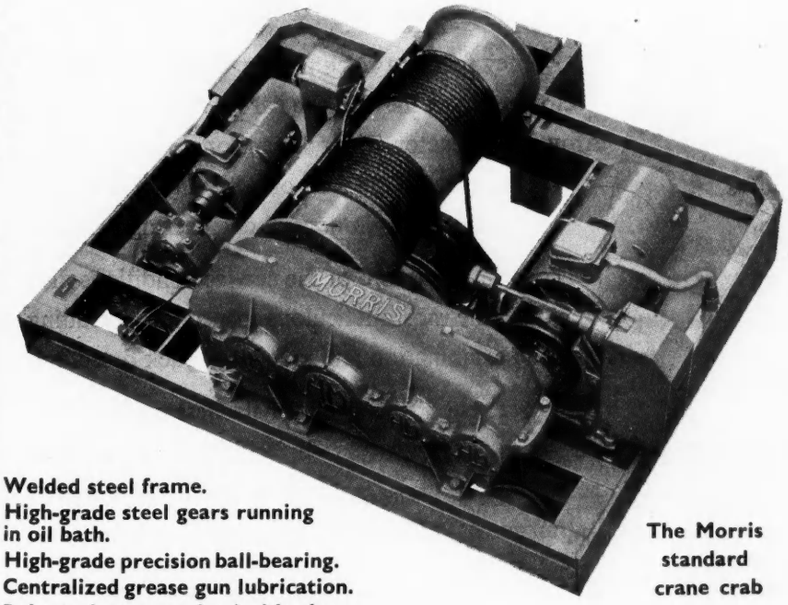


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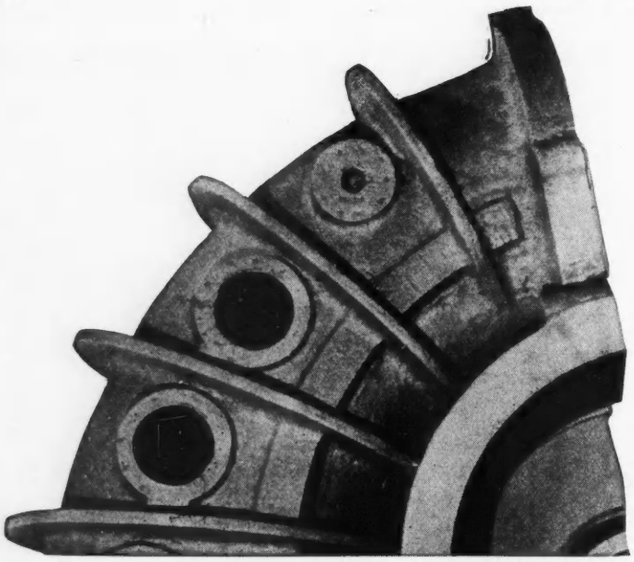
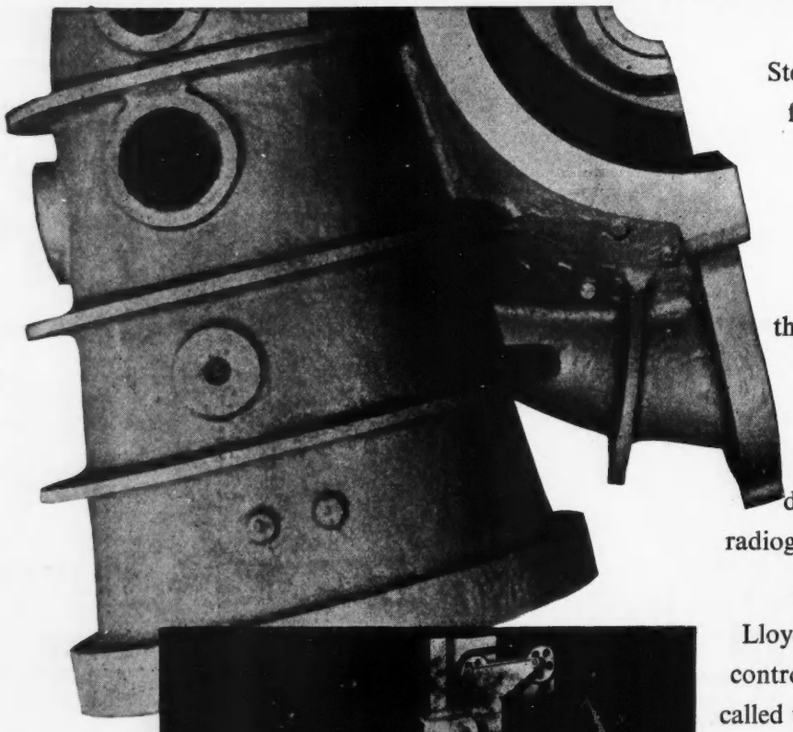


*Half gas circulator casing cast in steel and machined for C. A. Parsons & Co. Ltd. for Nuclear Power Station, Calder Hall. Weight as cast 35 tons. Sectional thickness max 7" min 1½". Reproduced by permission of C. A. Parsons & Co. Ltd.*

# cast and machined for an important part



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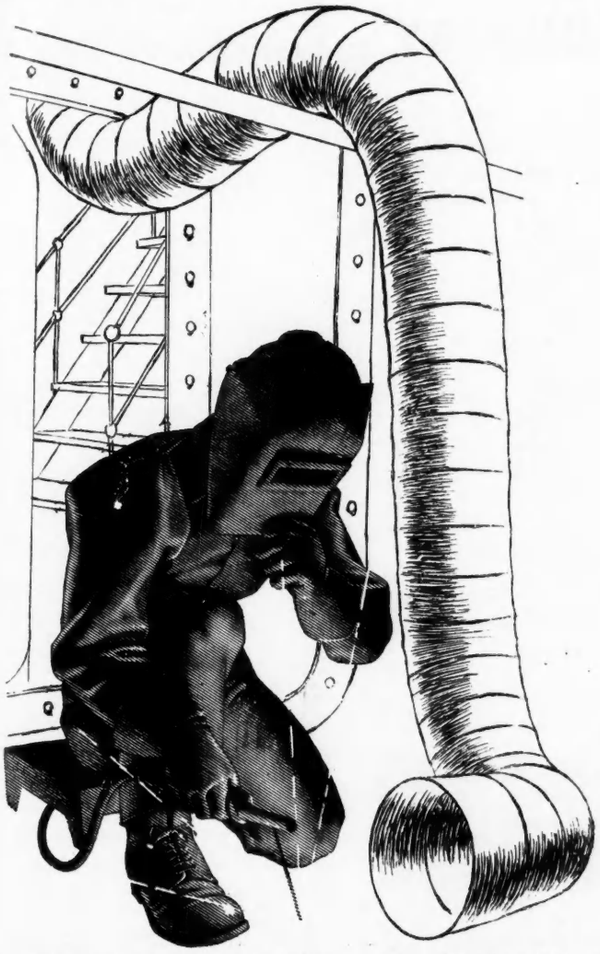

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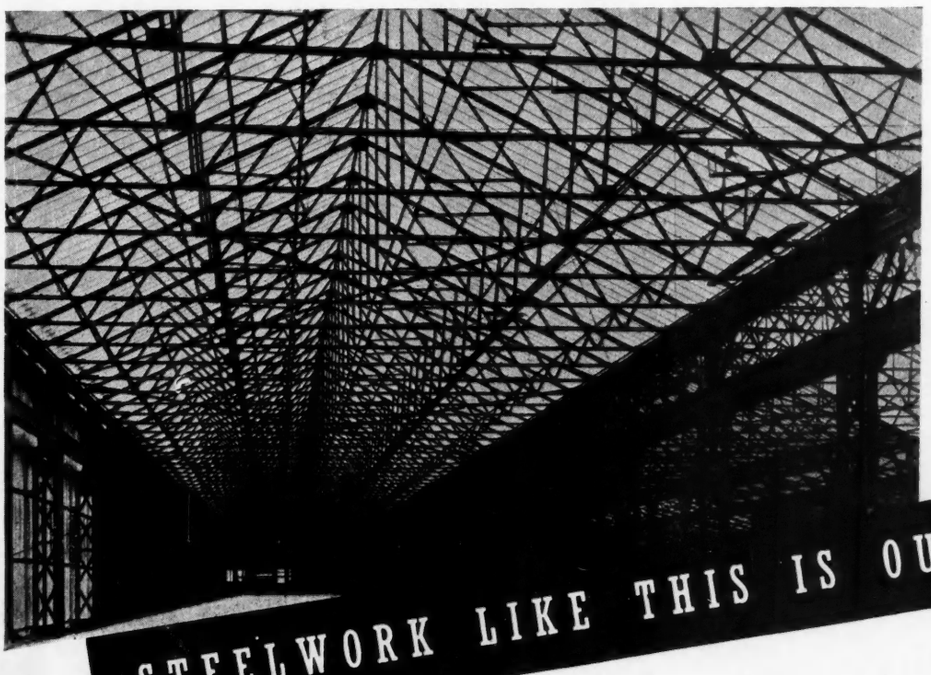

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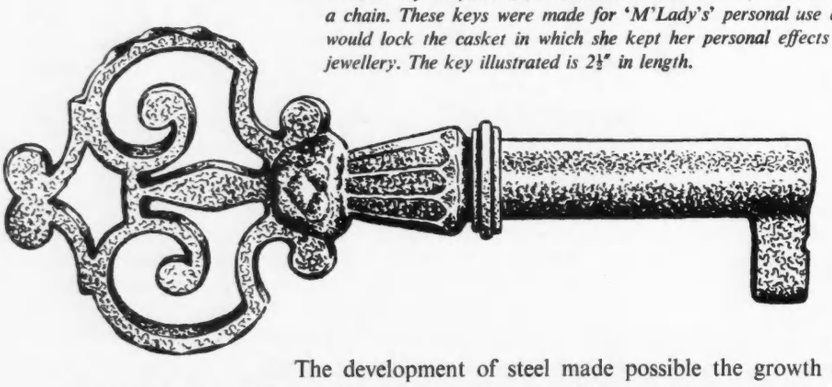

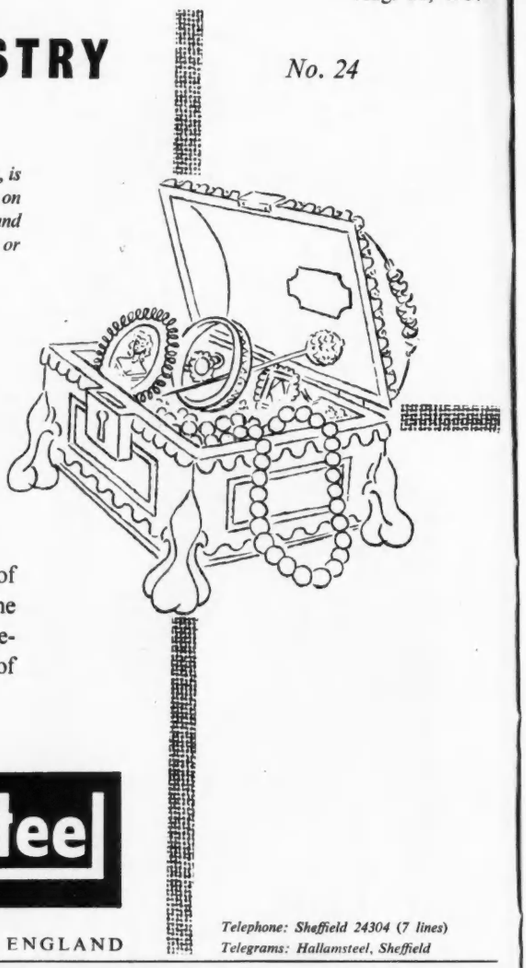

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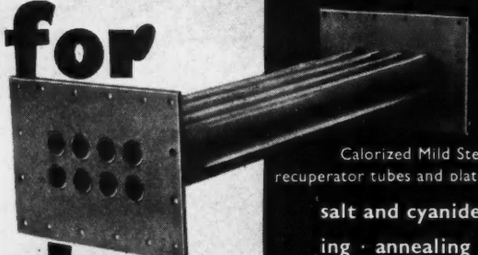

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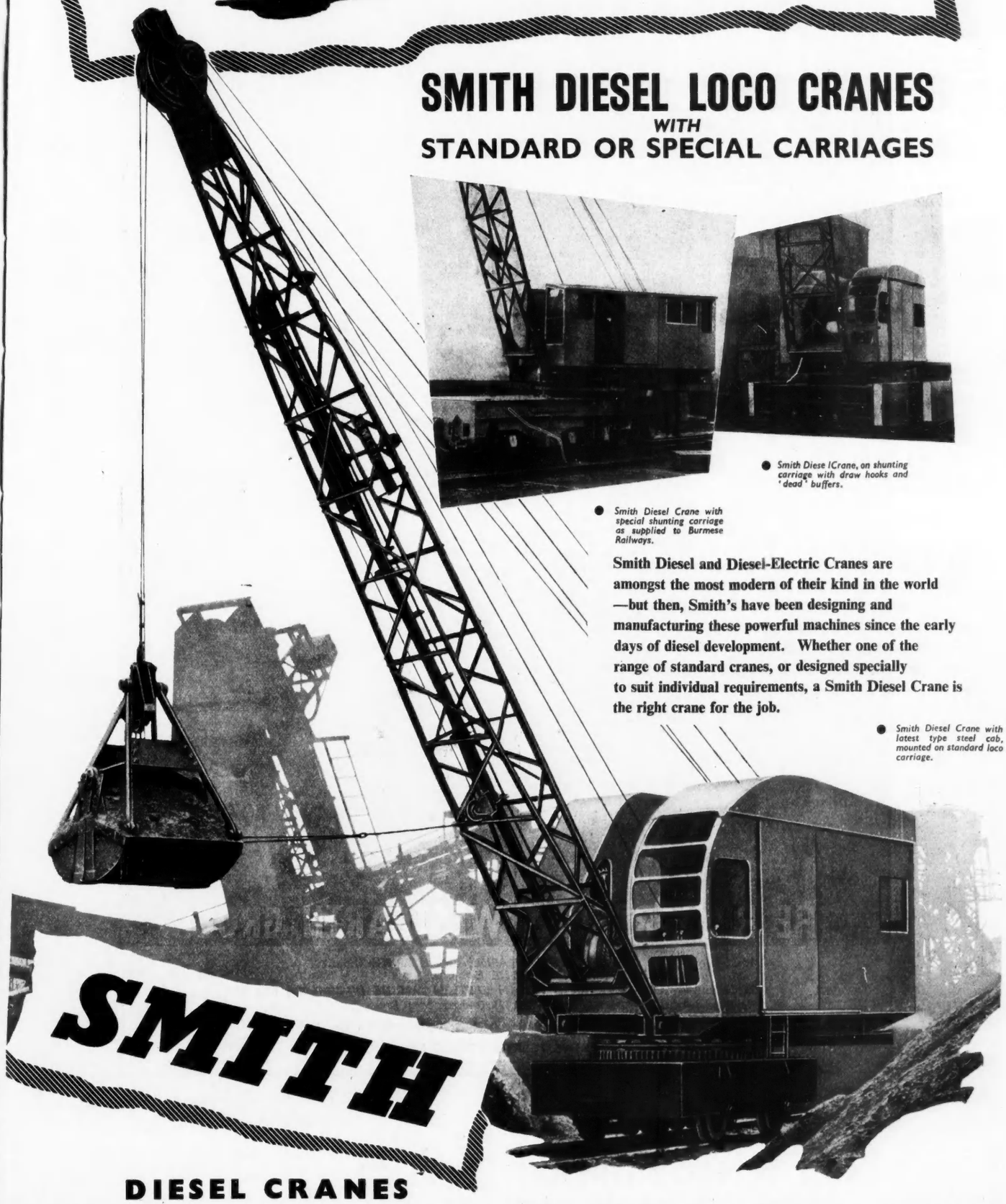

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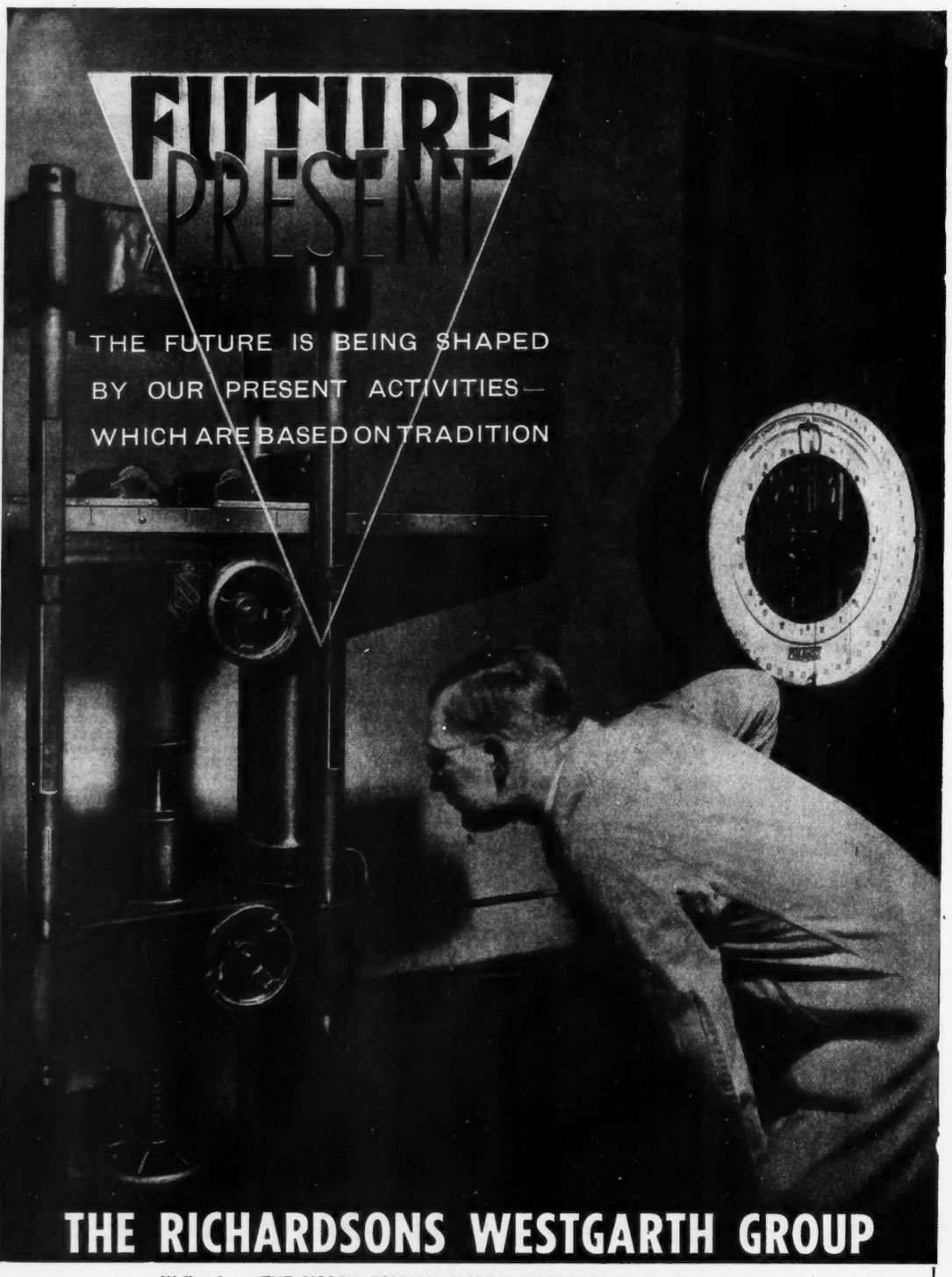


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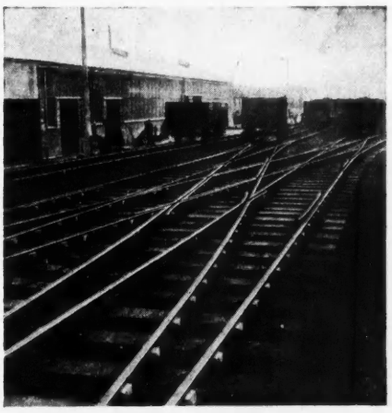

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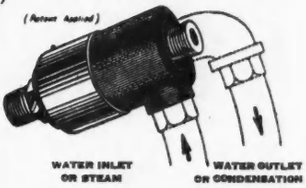


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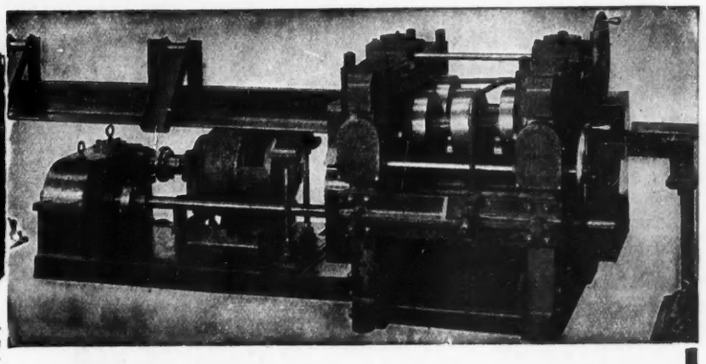

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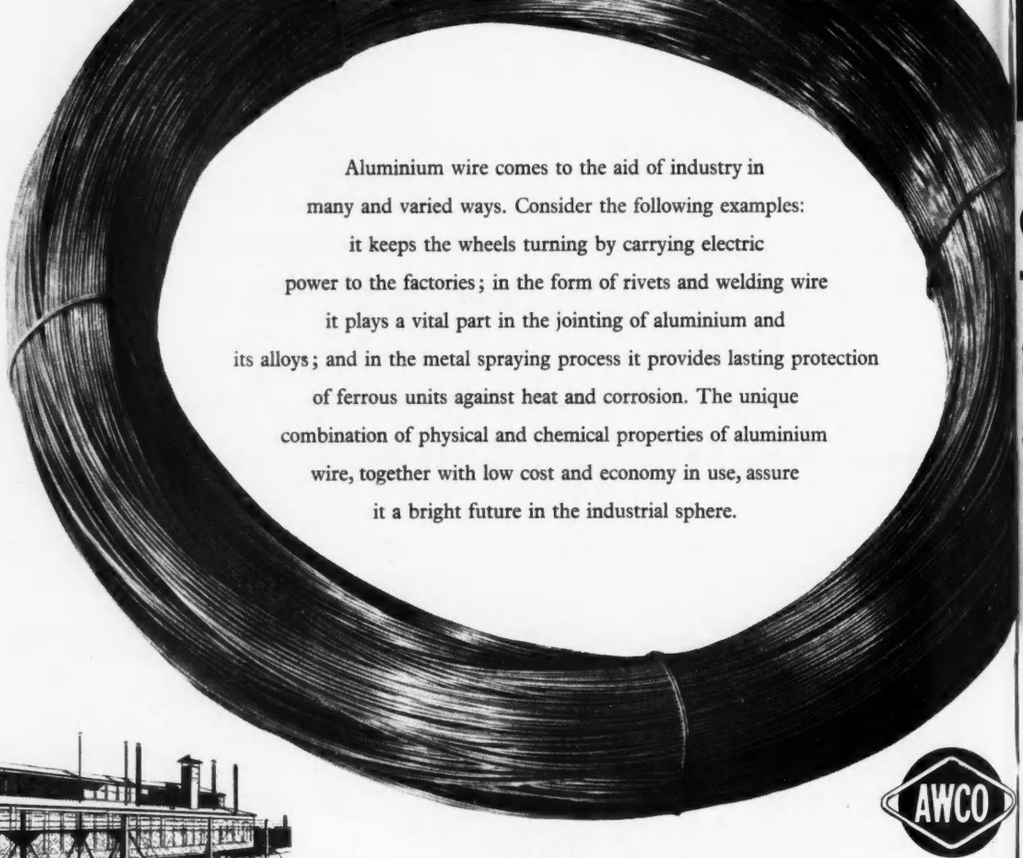

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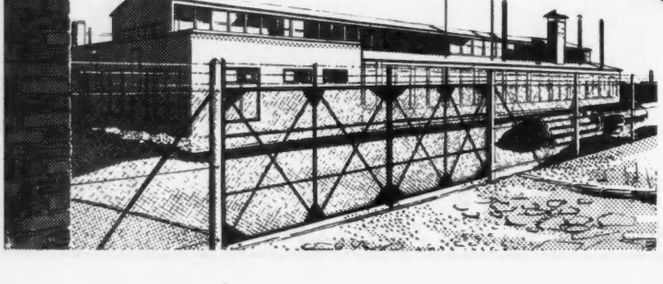

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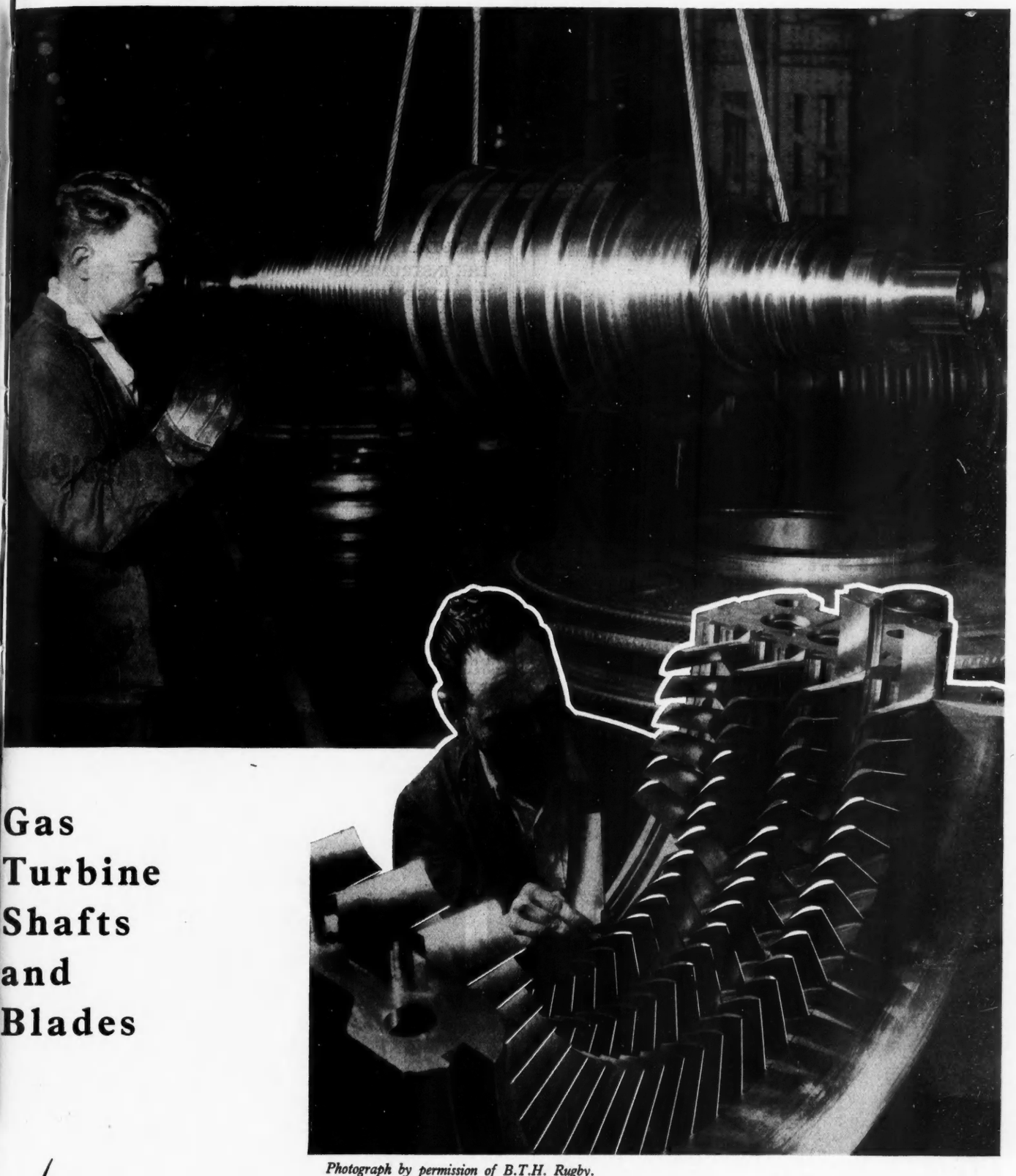

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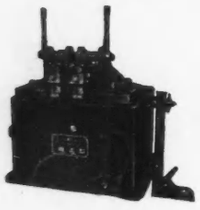

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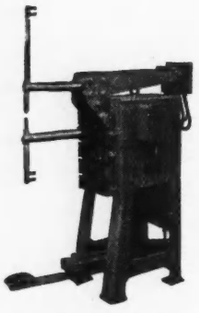

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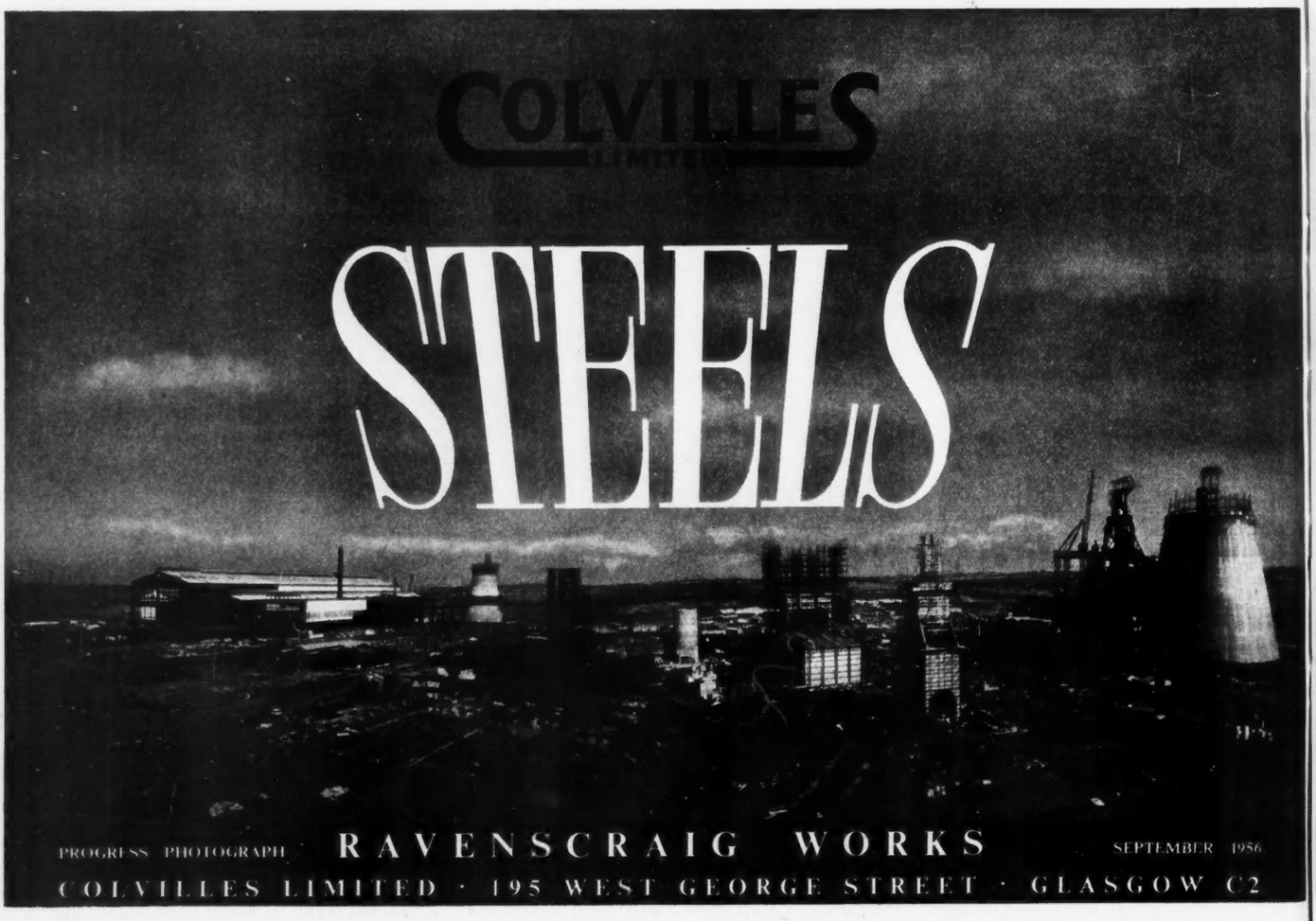

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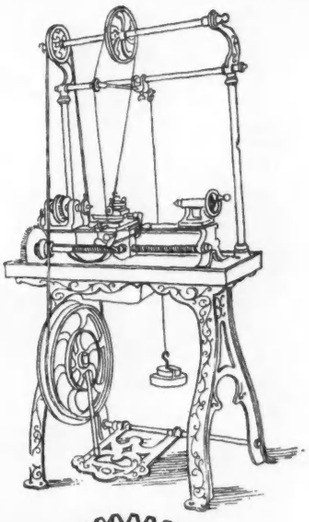

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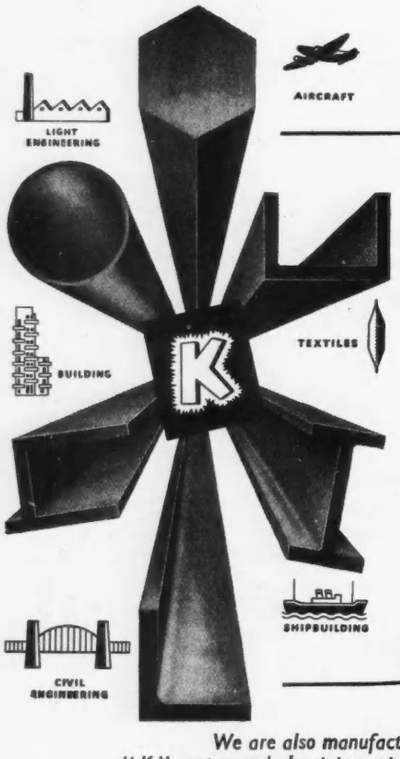


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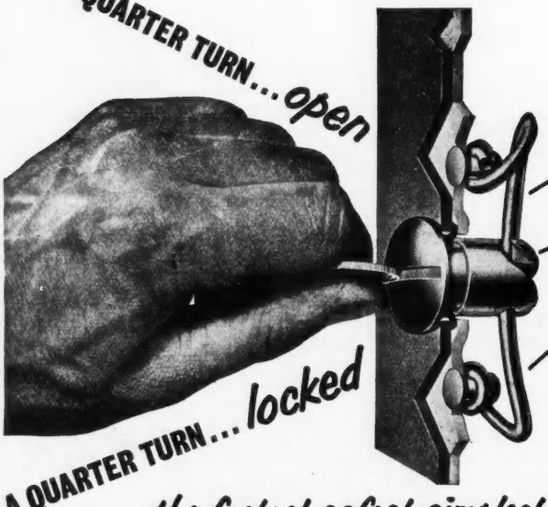

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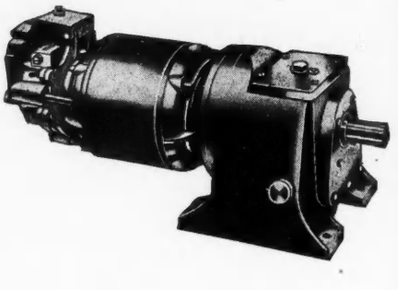

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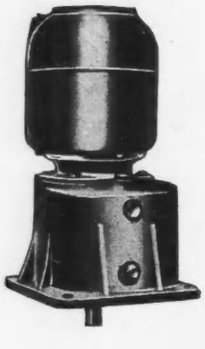

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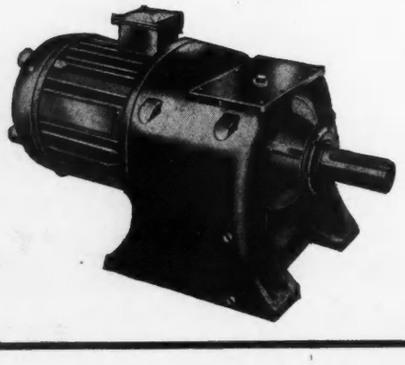

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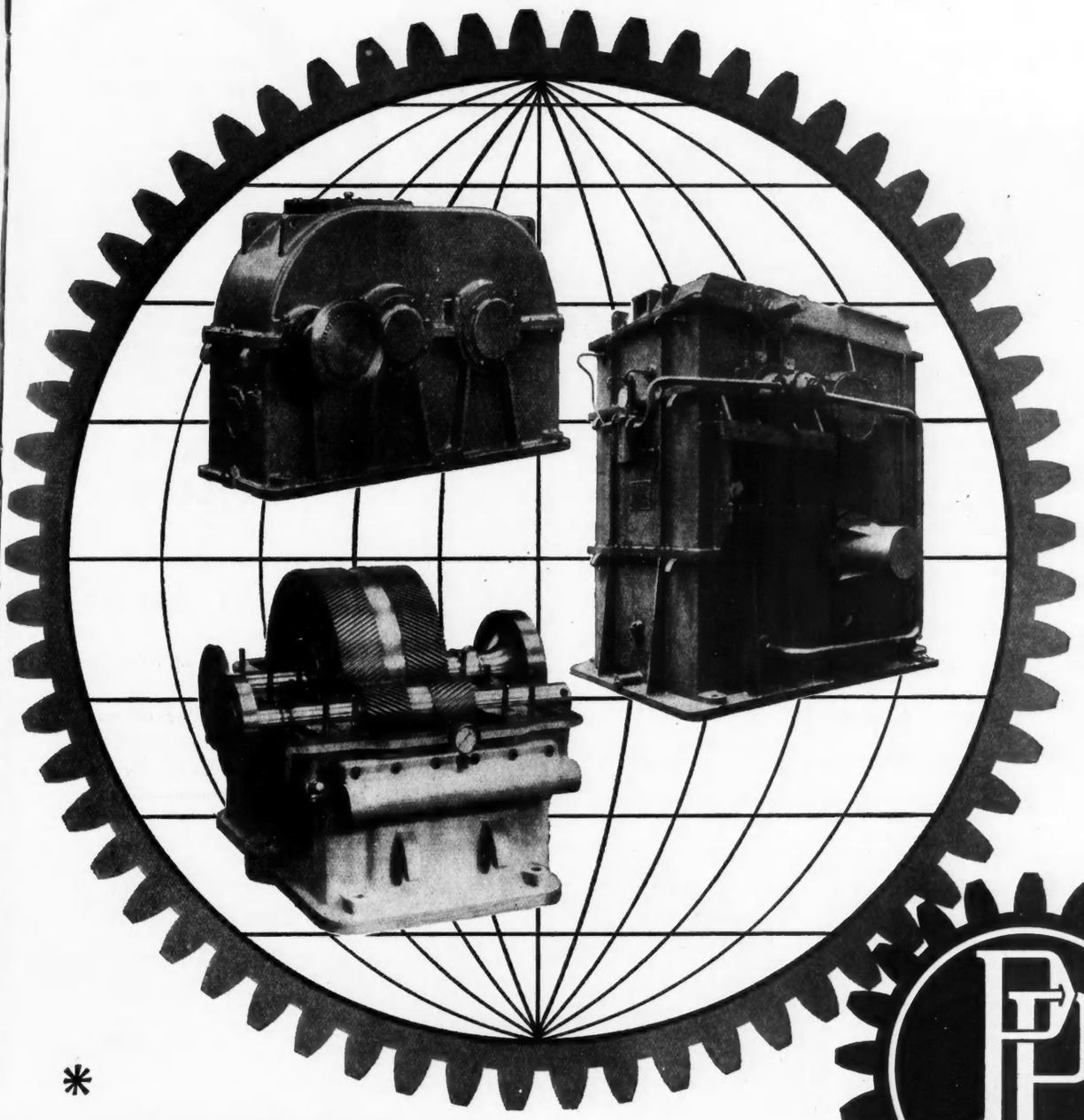

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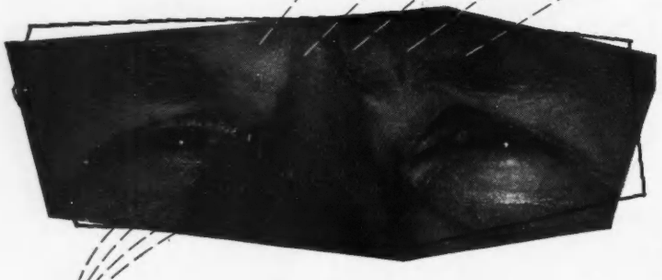

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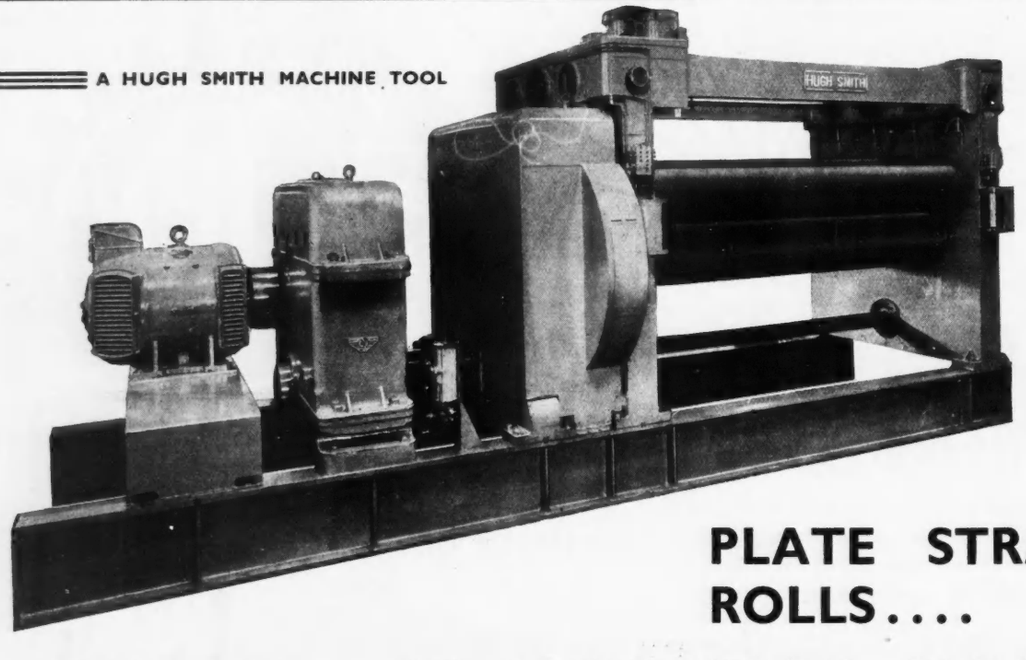


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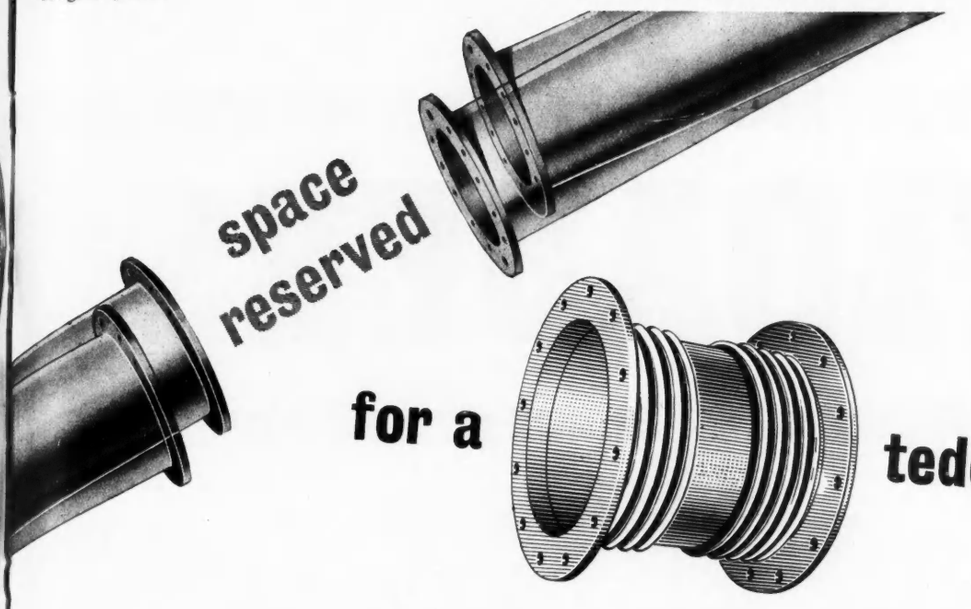

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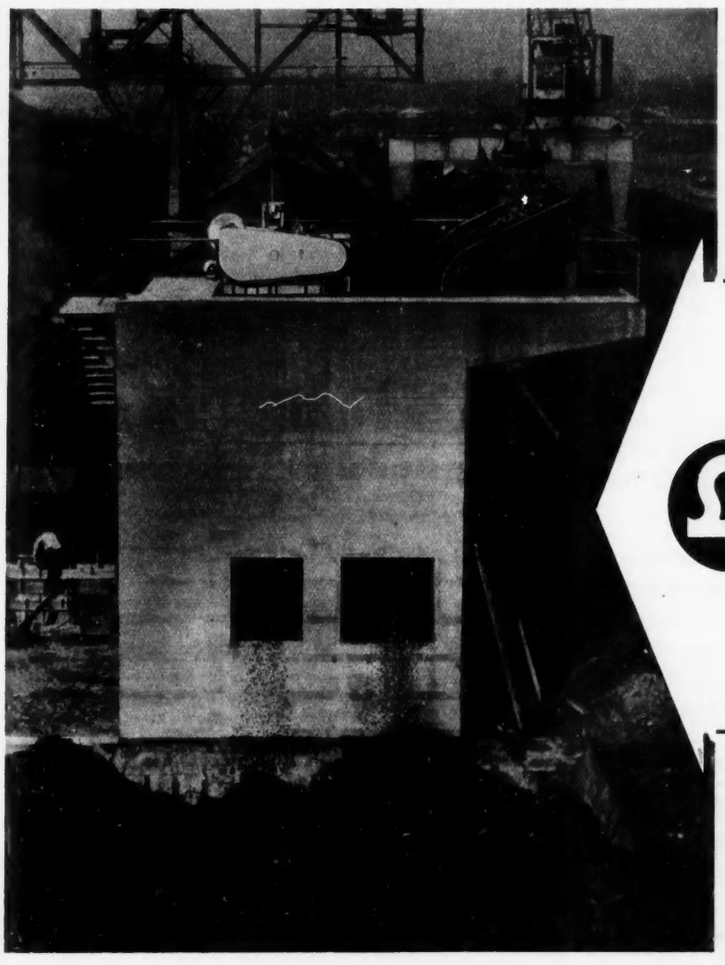

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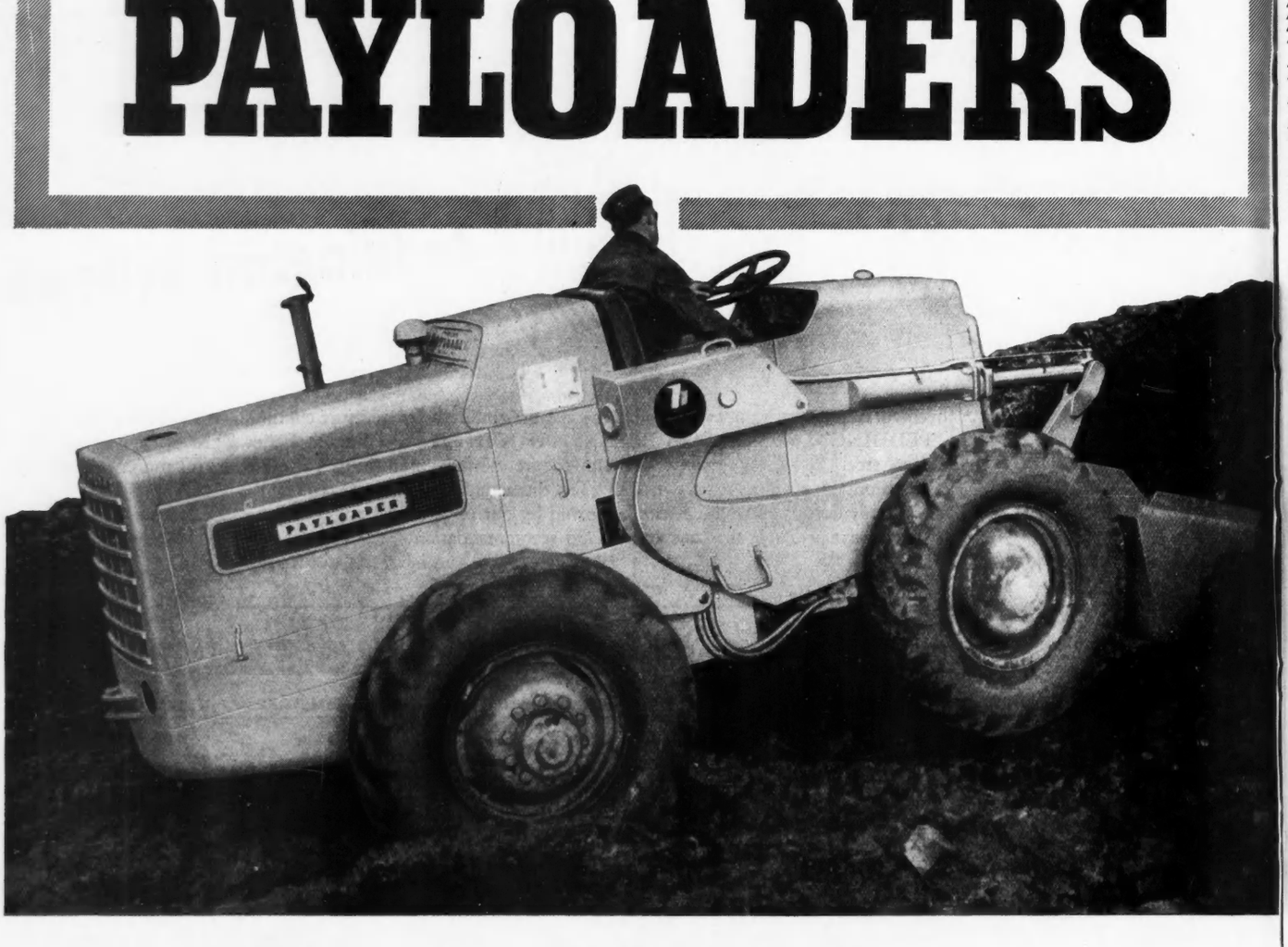


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# INDEX TO ADVERTISERS


| | PAGE |
|---|---|
| A.C.V. Sales, Ltd. | 113 |
| Abbott & Co. (Newark), Ltd. | 42 |
| Aerospray Associated, Ltd. | 135 |
| Air Industrial Developments, Ltd. | 99 |
| Aiton & Co., Ltd. | 16 |
| Alexander, G. H., Machinery, Ltd. | 118 |
| Allen, W. H., Sons & Co., Ltd. | 33 |
| Allott Bros. & Leigh, Ltd. | 109 |
| Aluminium Wire & Cable Co., Ltd. | 126 |
| Amal, Ltd. | 25 |
| Anderson, C. F., & Son, Ltd. | 94 |
| Anderton, W. R., & Co., Ltd. | 87 |
| Ardleigh Engineering, Ltd. | 117 |
| Arkinstall Bros., Ltd. | 62 |
| Ashmore, Benson, Pease & Co. | 17 |
| Associated Lead Manufacturers, Ltd. | 61 |
| Automotive Products Co., Ltd. | 49 |
| Avica Equipment, Ltd. | 65 |
| Barlow-Whitney, Ltd. | 118 |
| Barron, W. S., & Son, Ltd. | 118 |
| Barr, Thomson & Co., Ltd. | 76 |
| Bernfeld, E. H., Ltd. | 53 |
| Berrick Bros., Ltd. | 27 |
| Birlec, Ltd. | 32 |
| Black & Decker, Ltd. | 51 |
| Booth, J., & Bros. | 136 |
| Bostock & Bremley, Ltd. | 103 |
| Boulton & Paul, Ltd. | 35 |
| Boulton Paul Aircraft, Ltd. | 14 |
| Braby, F., & Co., Ltd. | 48 |
| Brackett, F. W., & Co., Ltd. | 104 |
| British Aluminium Co., Ltd. | 115 |
| British Ermeto Corp., Ltd. | 63 |
| British Federal Welder & Machine Co., Ltd. | 128 |
| British Steam Specialties, Ltd. | 51 |
| British Thomson - Houston Co., Ltd. | 77 |
| Bronx Engineering Co., Ltd. | 45 |
| Broughton, J., & Sons (Engrs.), Ltd. | 107 |
| Brown, D. (Brownall), Ltd. | 46 |
| Brown, D., Corporation (Sales), Ltd. | 58–101 |
| Brown, R. (Espedair Foundries), Ltd. | 106 |
| Brownlie & Murray, Ltd. | 46 |
| Brush Electrical Engineering Co., Ltd. | 13 |
| Buchanan Bros., Ltd. | 128 |
| Buckau R. Wolf | 43 |
| Budenberg Gauge Co., Ltd. | 106 |
| Bullers, Ltd. | 72 |
| Butcher, H., & Co. | 2 |
| C.A.V., Ltd. | 38 |
| C. & M. Engineering Co., Ltd. | 25 |
| Caird & Rayner, Ltd. | 106 |
| Caledonian Metal Co., Ltd. | 62 |
| Calorizing Corporation of Great Britain, Ltd. | 122 |
| Carr, C., Ltd. | 100 |
| Carruthers, J. H., & Co., Ltd. | 44 |
| Carter, B. & F., & Co., Ltd. | 109 |
| Celoform (Stockport), Ltd. | 88 |
| Chance Bros., Ltd. | 132 |
| Charles (Wednesbury), Ltd. | 53 |
| Clyde Crane & Booth, Ltd. | 136 |
| Clyde Crane & Engineering Co. | 136 |
| Clyde Structural Iron Co., Ltd. | 121 |
| Cohen, G., Sons & Co., Ltd. | 75 |
| Cole, E. R., Ltd. | 53 |
| Coltman, Walter W., & Co. (Boilers), Ltd. | 132 |
| Colt Ventilation, Ltd. | 41 |
| Colvilles, Ltd. | 128 |
| Consolidated Pneumatic Tool Co., Ltd. | 67 |
| Cooke, W., & Co., Ltd. | 52 |
| Cooper & Co. (B'ham), Ltd. | Cover ii |
| Cooper Roller Bearings Co., Ltd. | 60 |
| Cory Brothers & Co., Ltd. | 12 |
| Cossentine Bolt & Engineering Co., Ltd. | 10 |
| Cox & Danks, Ltd. | 31 |
| Crane, Ltd. | 56 |
| Crofts (Engineers), Ltd. | 98 |
| Crossley Brothers, Ltd. | 18 |
| Cross Manufacturing Co. (1938), Ltd. | 62 |
| Crow, Hamilton & Co., Ltd. | 125 |
| Cummins Diesel Sales & Service, Ltd. | 80 |
| Darlington, J. (Engineers), Ltd. | 110 |
| Dashwood & Partners, Ltd. | 107 |
| Dawson & Downie, Ltd. | 31 |
| Distington Engineering Co., Ltd. | 37 |
| Dorman Long (Steel), Ltd | 100 |
| Drysdale & Co., Ltd. | 54 |
| Ductile Sheet Stockists, Ltd. | 87 |
| Dzus Fastener, Europe, Ltd. | 130 |
| E.N.V. Engineering Co., Ltd. | 69 |
| Edwards, F. J., Ltd. | 11 |
| Electrical Energy | 7 |
| Electromagnets, Ltd. | 128 |
| Electronic Engineering | 91 |
| Electropower Gears, Ltd. | 130 |
| Elgood, E. J., Ltd. | 111 |
| Elliott-Lucas, Ltd. | 104 |
| Elliston, Evans & Jackson, Ltd. | 104 |
| Eltron (London), Ltd. | 31 |
| Evans, F. W., Ltd. | 114 |
| Expert Tool Heat Treatments, Ltd. | 106 |
| Farmer, L., & Sons | 2 |
| Feedwater Specialists Co. | 11 |
| Fenter, Ltd. | 132 |
| Ferranti, Ltd. | 76 |
| Fife Forge Co., Ltd. | 67 |
| Filton, Ltd. | 125 |
| Firth, T., & Brown, J., Ltd. | 127 |
| Fleming & Ferguson, Ltd. | 56 |
| Flexible Ducting, Ltd. | 121 |
| Follsain-Wycliffe Foundries, Ltd. | 117 |
| Foord, J., & Co. | 2 |
| Forster, T. S., & Sons, Ltd. | 72 |
| Forward Radiator Co., Ltd. | 107 |
| Foster Wheeler, Ltd. | 52 |
| Fuel Firing, Ltd. | 22 |
| Fuller, Horsey, Sons & Cassell | 2 |
| Garringtons, Ltd. | 25 |
| Gas Council | 84–85 |
| Geipel, W., Ltd. | 62 |
| General Electric Co., Ltd. | 42–114 |
| Gibson, A. L., & Co., Ltd. | 118 |
| Gibson, J., & Son, Ltd. | 66 |
| Goodwin, R., & Sons (Engineers), Ltd. | 109 |
| Goodyear Tyre & Rubber Co. (Gt. Britain), Ltd. | 60 |
| Govan Shafting & Engineering Co. | 25 |
| Greening, N., & Sons, Ltd. | 91 |
| Gresham Transformers, Ltd. | 34 |
| Hallamshire Steel & File Co., Ltd. | 122 |
| Harland Engineering Co., Ltd. | 105 |
| Harper, J., & Co., Ltd. | 46 |
| Harvey, G. A., & Co. (London), Ltd. | 90 |
| Head Wrightson Processes, Ltd. | 81 |
| Hermetic Rubber Co., Ltd. | 28 |
| Hick Hargreaves & Co., Ltd. | 103 |
| Holbrook | 22 |
| Holland Foundry, Ltd. | 31 |
| Hopkinsons, Ltd. | 68 |
| Hudson, R., Ltd. | 57 |
| Huntingdon Rubber Co., Ltd. | 104 |
| Imperial Chemical Industries, Ltd. | 108 |
| Ince Forge Co. | 125 |
| International Harvester Co. of Great Britain, Ltd. | 134 |
| Isler, C., & Co., Ltd. | 68 |
| Kay & Co. (Engineers), Ltd. | 80 |
| Kaye, E. & E., Ltd. | 130 |
| Kearns, H. W., & Co., Ltd. | 36 |
| Kirk & Co. (Tubes), Ltd. | 111 |
| Kosine, Ltd. | 11 |
| Krupp, Fried. | 39 |
| Kubach, F. W., Ltd. | 62 |
| Lang Pneumatic, Ltd. | 96 |
| Lee, W., & Sons | 58 |
| Leeds & Bradford Boiler Co., Ltd. | 67 |
| Leeds Engineering & Hydraulic Co., Ltd. | 110 |
| Levermore, A., & Co., Ltd. | 125 |
| Lewis & Tylor, Ltd. | 27 |
| Lincoln Electric Co., Ltd. | 20 |
| Lindemann Maschinenfabrik, G.m.b.H. | 133 |
| Linread, Ltd. | 21 |
| Lloyd, F. H., & Co., Ltd. | 120 |
| Lockwood & Carlisle, Ltd. | 109 |
| Macdonald, J., & Co. (Pneumatic Tools), Ltd. | 104 |
| MacLellan, P. & W., Ltd. | 114 |
| Mancuna Engineering, Ltd. | 55 |
| Marsden, S., & Son, Ltd. | 99 |
| Marshall Fleming & Co., Ltd. | 104 |
| Mather & Platt, Ltd. | 94 |
| Matthew Hall Group of Companies | 50 |
| Maxim Conveyors (England), Ltd. | 107 |
| Maxseal Valves, Ltd. | 118 |
| Measurement, Ltd. | 116 |
| Metafiltration Co., Ltd. | 80 |
| Metal Constructions, Ltd. | Cover ii |
| Metallic Valve Co., Ltd. | 23 |
| Metropolitan - Vickers Electrical Co., Ltd. | 82 |
| Minnesota Mining & Manufacturing Co., Ltd. | 51 |
| Moffat & Bell, Ltd. | 133 |
| Monk, A., & Co., Ltd. | 59 |
| Morgan Crucible Co., Ltd. | Cover iii |
| Morris, H., Ltd. | 119 |
| Moss Gear Co., Ltd. | Cover iv |
| Munro & Miller, Ltd. | 114 |
| Murex Welding Processes, Ltd. | 78 |
| Neco Geared Motors, Ltd. | 64 |
| Newalls Insulation Co., Ltd. | 79 |
| Newbury Diesel Co., Ltd. | 109 |
| North British Rubber Co., Ltd. | 83 |
| Oddie, Bradbury & Cull, Ltd. | 64 |
| Opperman Gears, Ltd. | 40 |
| Opperman, S. E., Ltd. | 129 |
| Osborn, S., & Co., Ltd. | 112 |
| Parker, F., Ltd. | 83 |
| Pinchin Johnson & Co. | 55 |
| Plus Gas Co., Ltd. | 72 |
| Pollock, Macnab & Highgate | 99 |
| Pool, J. & F., Ltd. | 64 |
| Power Plant Co., Ltd. | 131 |
| Priest Furnaces, Ltd. | 56 |
| Quasi-Arc, Ltd. | 95 |
| Ransomes & Rapier, Ltd. | Cover i |
| Renold Chains, Ltd. | 93 |
| Renshaw Foundry, Ltd. | 91 |
| Richards, C., & Sons, Ltd. | 23 |
| Richardsons Westgarth Group | 124 |
| Ross, D., & Partners, Ltd. | 29 |
| Rowlinson-Broughton | 23 |
| Ruberoid Co., Ltd. | 73 |
| Ruhrstahl, A.G. | 19 |
| Ruston & Hornsby, Ltd. | 70 |
| Sankey, J., & Sons, Ltd. | 86 |
| Savery, T., Pumps, Ltd. | 28 |
| Schieldrop & Co., Ltd. | 74 |
| Scriven Machine Tools, Ltd. | 99 |
| Sespa, U.K., Ltd | 97 |
| Sharp Control Gear, Ltd. | 27 |
| Shawe Metal Spinning Works | 42 |
| Sheet Metal Shapes, Ltd. | 56 |
| Smedley Bros., Ltd. | 62 |
| Smith & McLean, Ltd. | 45 |
| Smith, I., & Co. (Possil), Ltd. | 132 |
| Smith, J. W. (Coventry), Ltd. | 31 |
| Smith, T., & Sons (Rodley), Ltd. | 123 |
| Smiths Industrial Instruments, Ltd. | 71 |
| Southern Instruments, Ltd. | 66 |
| Spencer - Bonecourt - Clarkson, Ltd. | 42 |
| Sperry Gyroscope Co., Ltd. | 47 |
| Steam Storage Co., Ltd. | 64 |
| Sugden, T., Ltd. | 28 |
| Sulzer Bros. (London), Ltd. | 89 |
| Swain, J., & Son, Ltd. | 126 |
| T. & T. Works, Ltd. | 66 |
| Teddington Aircraft Controls, Ltd. | 133 |
| Telco, Ltd. | 109 |
| Thorn, J., & Sons, Ltd. | 113 |
| TI Aluminium, Ltd. | 92 |
| Tonks, J., & Co., Ltd. | 67 |
| United Filters & Engineering, Ltd. | 113 |
| Varatio-Strateline Gears, Ltd. | 96 |
| Vaughan, E., & Co., Ltd. | 79 |
| Visco Engineering Co., Ltd. | 45 |
| Vokes, Ltd. | 102 |
| Ward, T. W., Ltd | 10–60–125 |
| Wareing Bros. & Co., Ltd. | 32 |
| Warren, Morrison, Ltd. | 64 |
| Wellington Tube Works, Ltd. | 88 |
| Wellman Bibby Co., Ltd. | 88 |
| Wells, A. C., & Co., Ltd. | 55 |
| West Ham Testing Laboratory | 118 |
| Wharton Crane & Hoist Co. Ltd. | 30 |
| Wheatley Kirk, Price & Co. | 2 |
| Wickman, Ltd. | 1 |
| Widnes Foundry & Engineering Co., Ltd. | 26 |
| Wigglesworth, F., & Co., Ltd. | 99 |
| Wilkinson Rubber Linatex, Ltd. | 15 |
| Williamson, A. S. | 35 |
| Worthington-Simpson, Ltd. | 24 |
| Wright, R. O., & Co., Ltd. | 15 |
| Youngs (Lifting Appliances), Ltd. | 117 |



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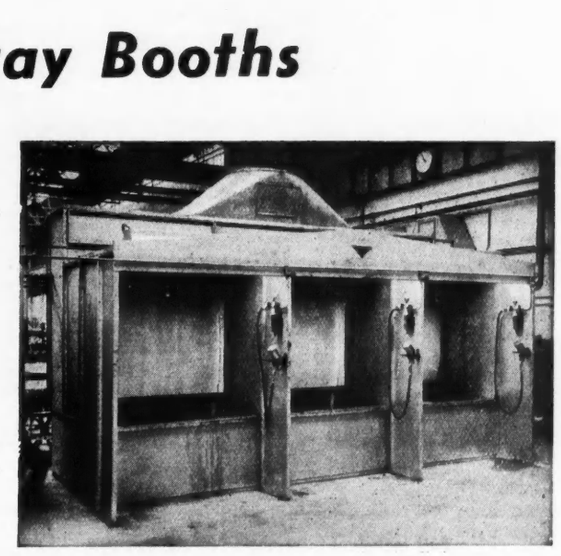

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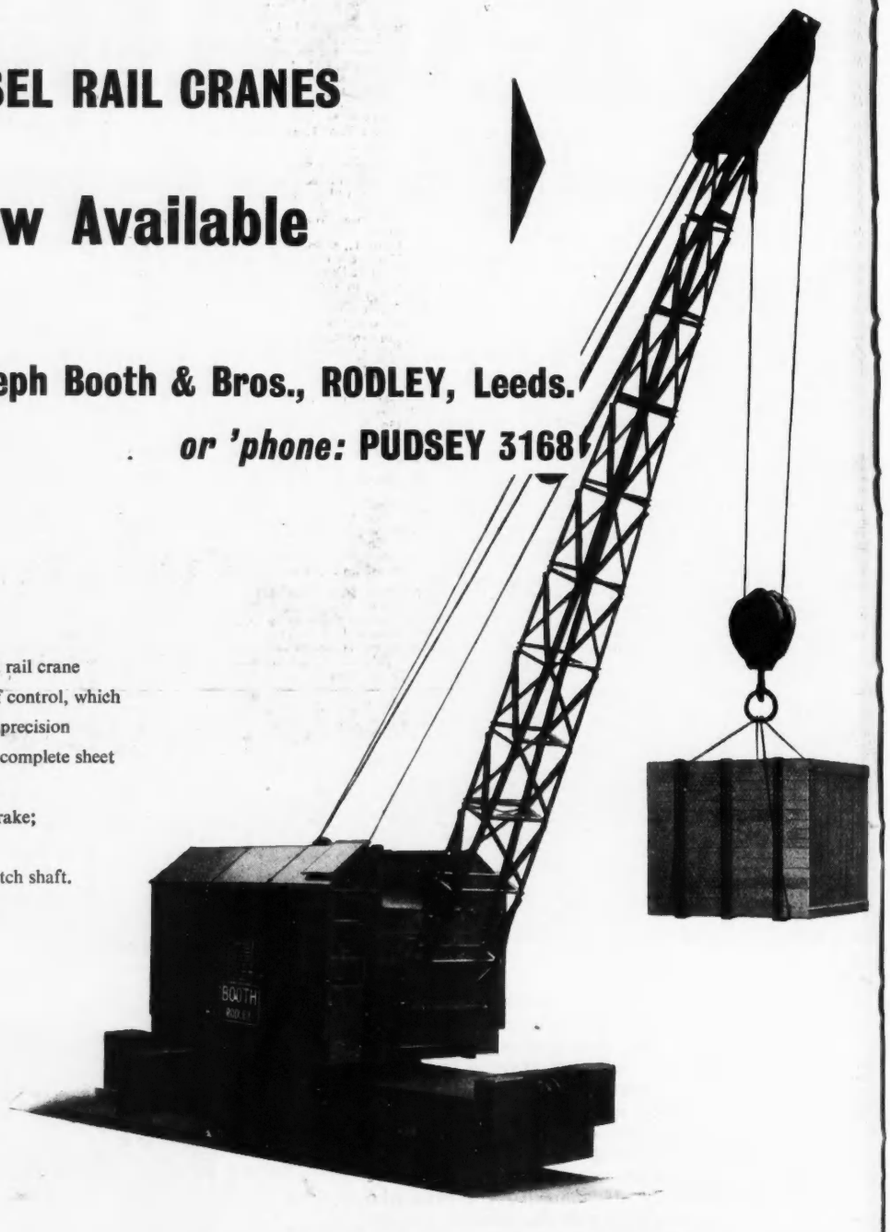

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The Engineer

AUGUST 30, 1957

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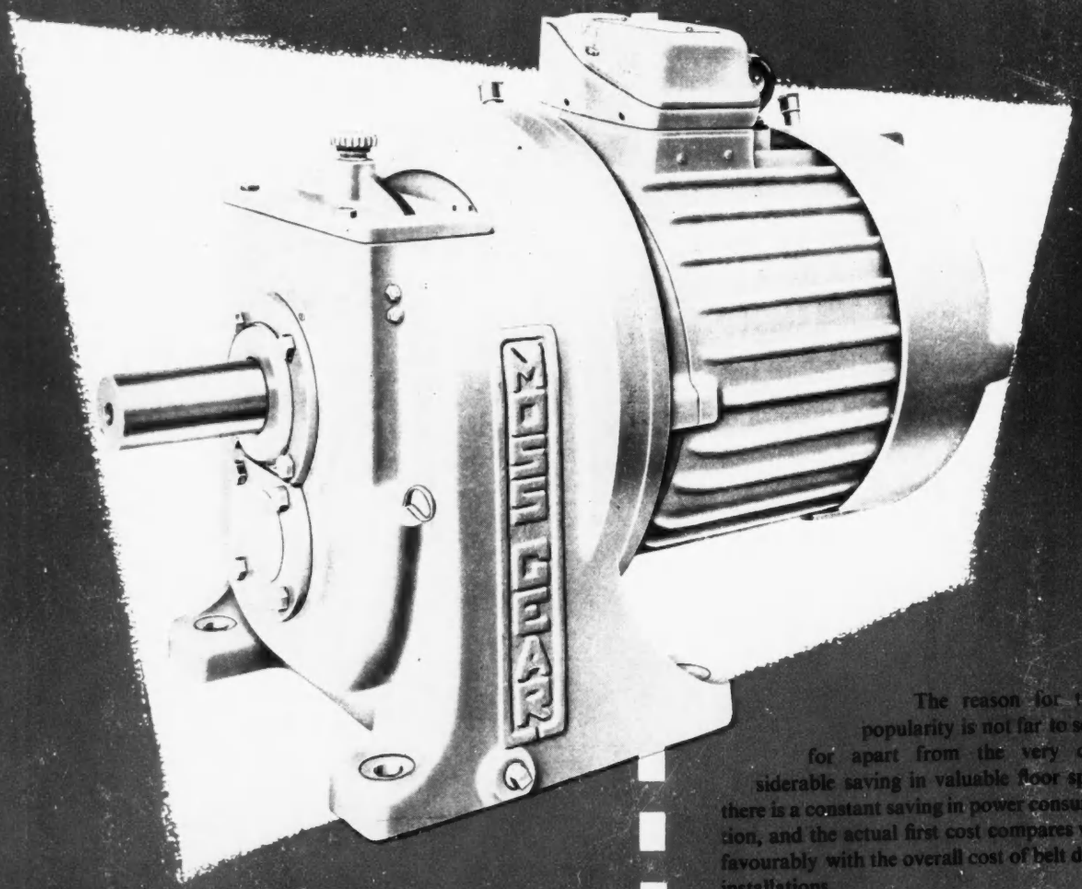


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# Personal and Business

## Appointments

MR. S. R. DONALDSON, A.M.I.E.E., has been appointed general manager of Newage (Manchester), Ltd.

MR. C. R. H. SIMPSON has been appointed assistant to the technical sales manager of Beyer Peacock and Co., Ltd.

MR. D. F. CAMPFIELD has been appointed national sales manager, photo records division, Remington Rand, Ltd.

MR. V. H. F. HOPKINS has been appointed manager of engineering, diesel engine division, of the English Electric Company, Ltd.

THE NATIONAL UNION OF MANUFACTURERS announces that Mr. Victor Berry has been appointed secretary of their South Wales branch.

G. AND J. WEIR, Ltd., announces that Mr. J. W. Atwell, M.Sc., M.I.Mech.E., has been appointed assistant managing director of the executive board.

VERITY'S, Ltd., announces that Mr. J. W. Seymour, B.Sc. (Eng.), has been appointed a director of the company and Mr. P. J. H. Coates, A.M.I.E.E., has now become managing director.

LONDON TRANSPORT has announced that Mr. L. C. Lloyd has been appointed assistant works superintendent (Aldenham) in the department of the chief mechanical engineer (road services).

THE MINISTRY OF SUPPLY has announced that Mr. J. Cushny has been promoted to director (engineer) and appointed chief engineer, Royal Aircraft Establishment, Farnborough.

MR. C. G. REDDINGTON, A.M.I.C.E., district engineer, King's Cross, has been appointed planning officer (King's Cross), in the office of the general manager, Eastern Region, British Railways, Liverpool Street.

CROMPTON PARKINSON, Ltd., announces that Mr. H. Astbury, M.I.E.E., the firm's chief engineer, having reached normal retiring age, has relinquished his appointment which he has held since 1945. He will, however, continue with the company in an advisory capacity. He is succeeded by his deputy, Mr. W. A. McNeill, B.Sc. (Tech.), M.I.E.E.

H. LEVERTON AND CO., Ltd., Caterpillar dealers for the northern half of England, announces the appointment of three area sales managers. They are : Mr. M. Cummins (Leeds), Mr. J. A. Needham (Wigan), and Mr. R. C. Eltringham (Gateshead). Each sales manager will be responsible to Mr. J. G. Smith, the northern area sales director of Levertons.

THE NATIONAL COAL BOARD announces that it has appointed Mr. C. G. Simpson, O.B.E., to be its director-general of staff, and Mr. J. V. Wood, director-general of industrial relations. Mr. Simpson, who is at present deputy director-general of the staff department, succeeds Mr. J. O. Blair-Cunynghame, O.B.E., who was recently appointed by the Minister of Power to be a member of the Board. Mr. Simpson's appointment takes effect immediately. Mr. Wood, the staff director of the Board's northern division, will succeed Mr. A. Walsh, M.B.E., who is to become deputy chairman of the south-western division. Mr. Wood will take up his new appointment on November 18.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., announces that Mr. H. C. Young has relinquished his duties as superintendent, Erection Department, but will remain in the service of the company as consulting engineer. Mr. A. P. Mitchell succeeds him as superintendent, Erection Department. Mr. W. Harper has been appointed assistant superintendent (Switchgear) Erection Department, and Mr. A. D. Millar assistant superintendent (Plant) Erection Department. Mr. B. G. Churcher has relinquished his position as manager of the Research Department but will continue to act in an advisory capacity. Dr. J. M. Dodds, O.B.E., M.A., B.Sc., B.Sc. (Eng.), Dr.-Ing. (Aachen), succeeds him as manager of the Research Department. Mr. M. Bird, A.M.I.E.E., assistant superintendent Insulation Department, has been appointed superintendent Insulation Department and Bury factory. Mr. D. B. Johnston, B.Sc. (Eng.), A.M.I.E.E., has been appointed assistant superintendent Plant Department, and Mr. N. Bradshaw has been appointed assistant superintendent, Foundries and Pattern Shop. Mr. P. O'B. Hove, B.Sc. (Eng.), A.M.I.E.E., A.M.I. Mech.E., has been appointed resident manager, Middle East, of the Metropolitan-Vickers Electrical Export Company, Ltd. ; he will be located in Baghdad, Iraq.

## Business Announcements

G. APPLEGATE AND SONS, LTD., states that it has opened an office and works at Manvers Street, Bath (telephone, Bath 64147).

JENOLITE, LTD., has announced the appointment of Mr. V. Kronman, Nybrogade 14, Copenhagen K, as its new licensee and agent in Denmark.

PILOT WORKS, Ltd., of Bolton, has appointed the S.M.T. Sales and Service Company, Ltd., as their sole distributors for hydraulic tipping gears in Scotland.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., announces that, as and from August 31, 1957, the telephone number of the Edinburgh branch office will be Caledonian 6786/7/8.

COSTAIN-JOHN BROWN, LTD., states that it has opened a branch office of the instrumentation division at Jaffrey's Chambers, 63, Brown Street, Manchester, 2 (telephone, Blackfriars 5575).

WOLF ELECTRIC TOOLS, Ltd., announces that Mr. G. M. Wolfe, joint managing director of the company, sets out in mid-September on a three months' tour which will include visits to Canada, New Zealand, Australia, Malaya, Thailand and India.

THE HANWELL ENGINEERING COMPANY, Ltd., of Countess Road, Northampton, has been taken over by Pollard Bearings, Ltd., and the title of the company is now changed to Pollard Bearings (Northampton), Ltd. The telephone number remains as at present—Northampton 3766/7/8.

THE PRESIDENT OF THE BOARD OF TRADE, the Rt. Hon. Sir David Eccles, K.C.V.O., has this month accepted the award by the Council of the British Institute of Management of an honorary fellowship of the Institute. An honorary fellowship of the Institute is the highest award the council can offer and this is only the third time such an award has been made.

NEWALL GROUP SALES, Ltd., announces that the Newall Engineering Company, Ltd., of Peterborough, England, have formed a Canadian subsidiary company, The Newall Machine Tool Corporation of Canada, Ltd. The new company will be empowered to distribute in North America and to manufacture products of the parent organisation; the new company is registered in Toronto.

THERMOTANK, LTD., has announced that the address of its London office, with effect from September 2, will be the Marine Engineers' Memorial Building, 18, London Street, London, E.C.3 (telephone, Royal 7343-4). The telephone number of the offices and works of the Thermotank group at West Drayton, Middlesex, is to be changed to West Drayton 3685-9, also with effect from September 2.

HEAD WRIGHTSON PROCESSES, Ltd., of London, announces that an agreement has been signed with Inventa A.G., of Lucerne, Switzerland, which will enable the company to design and supply plants to the Inventa processes for the production of methanol and formaldehyde, in the United Kingdom and British Commonwealth (excluding Canada), and can now offer a complete service for the provision of these plants, from the design to the final commissioning.

D. NAPIER AND SON, Ltd., has contracted with R.E.A.L. S.A. Transportes Aereon, Brazil, for the conversion of three "Convairliner 340" aircraft to Napier "Eland" engines. The machines are expected to be flying by the end of 1958, and satisfactory operation will be followed by the conversion of the remainder of the "Convair 340" and "Metropolitan" machines. The conversion will be carried out by PacAero Engineering Corporation at Santa Monica, commencing August, 1958. Either the existing "Eland-Convairliner" or a "440" shortly to be converted to turbines will be used by R.E.A.L. for crew training and route familiarisation.

## Contracts

GLENFIELD AND KENNEDY, Ltd., Kilmarnock, has received an order valued at over £150,000, from the Ministry of Defence of the Republic of India, for all the large valves for the dry dock that is to form part of the new Naval Dockyard in Bombay.

CROMPTON PARKINSON, Ltd., announces that a further order has been received for eighteen electric traction equipments under the British Railways modernisation plan. The equipments are for type "B" diesel-electric locomotives of 1160 h.p., for freight and passenger services, which are to be built by the Birmingham Railway Carriage and Wagon Company, Ltd.

THE BRITISH TABULATING MACHINE COMPANY, Ltd., has received an order from the Durban City Council for a Hollerith type 1201 electric computer. The computer will be used for producing light and telephone accounts, at a rate of 1000 an hour, and will prepare municipal employees' paysheets and leave records. The city treasury calculates that, by diverting staff to more productive jobs, this computer will save ratepayers some £37,500 a year. Durban has a population of half-a-million.

ESSO PETROLEUM COMPANY, Ltd., announces that it has entered into an arrangement with Union Carbide, Ltd., whereby it will supply ethylene gas to the new £3,000,000 petrochemical plant which Union Carbide, Ltd., proposes to construct on a 52-acre leased site adjacent to the Esso refinery at Fawley. This new plant, scheduled for completion by 1959, will convert ethylene into a number of ethylene oxide derivatives. The Esso Petroleum Company will produce the ethylene in its new £9,000,000 chemical plant now under construction at the refinery.

THE BRITISH THOMSON-HOUSTON COMPANY has received a contract valued at nearly £100,000 for the largest blast-furnace turbo-blower supplied by the company for installation overseas. The order, which also includes condensing plant, is for the Algoma Steel Corporation of Canada, and was received through British Thomson-Houston Company (Canada), Ltd., of Toronto. The plant is normally rated at 85,000 cubic feet per minute, 30 lb per square inch gauge, but will be capable of dealing with the maximum volume of 100,000 cubic feet per minute at a discharge pressure of 20 lb per square inch gauge.

## Miscellanea

FIVE 200MW GENERATING SETS FOR WEST THURROCK POWER STATION.—The Central Electricity Authority has received the consent of the Minister of Power to the building of a new power station at West Thurrock, Essex, which will have an installed capacity of 1000MW. The installation will comprise five 200MW turbo-generator sets and five 200MW reheat boiler units, each having an evaporative capacity of 1,400,000 lb of steam an hour. The West Thurrock station is planned to be in commission by the winter of 1961.

BRITISH NUCLEAR EXHIBITS AT LEVANT FAIR.—The Board of Trade has arranged a display for the twenty-first Levant Fair, Bari, Italy, which is to be held from September 7 to 25, 1957. The display has been designed in conjunction with the U.K. Atomic Energy Authority and in consultation with industry. Models of Calder Hall and of the fast breeder reactor at Dounreay will be on view. Emphasis will be placed on British collaboration with other nations, and the readiness of British industry to meet world demand for nuclear equipment. A British film with an Italian sound track will show how a thermal reactor works.

FRENCH CO-OPERATION IN INDIAN RAILWAYS' ELECTRIFICATION.—French Railways, under a recent agreement, are to give technical assistance to the Indian Railways for the electrification of some 600 miles of line carrying heavy traffic in the Calcutta area. The system adopted for this project is that using single-phase current, at the industrial frequency as developed by the French Railways since the war. The agreement provides for close co-operation on the planning of the project, framing of specifications, negotiations with and the choice of contractors, the supervision of works, &c. French Railways also undertake to train Indian Railways' technicians in France, and to keep French technicians in India for a year after the electrification of each section of line to ensure that the equipment is working satisfactorily and that its maintenance is well organised.

CONFERENCE ON INDUSTRIAL CARBON AND GRAPHITE.—The Society of Chemical Industry is to hold a three-day conference on industrial carbon and graphite at the William Beveridge Hall, University of London, on September 24, 25 and 26. More than fifty papers have been submitted from Britain and abroad, and it has been decided to summarise them in selected groups so as to permit full discussion. Interest in the conference is reported from the U.S.A., U.S.S.R., France and the Netherlands. Prior registration for membership of the conference is possible through the assistant secretary, Society of Chemical Industry, 14, Belgrave Square, London, S.W.1, or the hon. secretary of the Conference Committee, Mr. E. A. Smith, Acheson Industries (Europe), Ltd., 18, Pall Mall, London, S.W.1. Members receive a set of preprints of the papers. A free exhibition will be held in the Department of Chemical Engineering, University College, Gower Street, London, W.C.1, during the period of the conference.

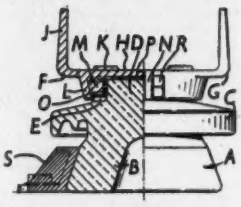
# British Patent Specifications

*When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.*

## ELECTRICAL ENGINEERING

**779,450.** April 25, 1956.—INSULATING SUPPORTS FOR ELECTRIC CONDUCTOR RAILS, Doulton and Co., Ltd., Doulton House, Albert Embankment, Lambeth, London, S.E.1. (*Inventor: Frank Audrey Hill.*)

The invention relates to insulating supports for electric conductor rails and in particular to supports for the conductor rails of electric railway systems. Referring to the drawing, an insulator body *A* is

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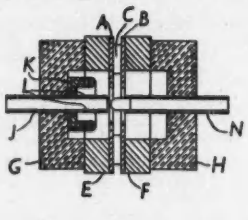
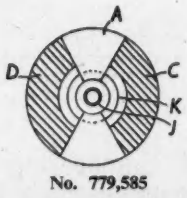
formed with a skirt or base portion *B*, a shed *C* and a head *D*. The head is generally an inverted truncated cone in shape and is formed with a pair of diametrically opposed radial slots *E*. A metal cap comprises two halves *F* and *G* which are identical in shape and therefore only one will be described in detail. The half *F* includes a semi-circular platform *H* from which extends an upright side wall *J* which engages with one side of a conductor rail. The rail rests on a raised pad *K* on the platform. A semi-circular flange *L* extends downwardly and inwardly inclined from the platform and surrounds one-half of the head. A projection *M* extends inwardly from the flange *L* and is received within the slot *E*. Extending from each end of the flange in an outwardly radial direction is a lug *N* which is provided with holes. It will be seen that the two halves *F* and *G* produce a cap with a recessed underpart adapted to fit on the head of the insulator body. A collar *O* surrounds the conical head *D* and acts as a cushion between the fitting portions of the head of surrounding flanges. A washer *P* is also interposed between the top of the head and the lower surface of the platform also acts as a cushion. The two halves of the cap are clamped together, with the flanges surrounding the conical head, by bolts *R*. The insulator body *A* is secured to the railway sleeper by means of a pair of clamping elements *S* which engage with the base of the skirt and are secured to the sleeper by coach screws. From the description it will be realised that in an insulating support, according to the invention, the cap is secured to the insulator body without the use of cement or the like, and should it be desired to replace either the insulator body or the cap, either of these parts may be detached and replaced without damage to the other.—*July* 17, 1957.

**779,585.** October 5, 1954.—BLOWN DISCHARGE GAP SWITCH, Metropolitan-Vickers Electrical Company, Ltd., St. Paul's Corner, 1–3, St. Paul's Churchyard, London, E.C.4. (*Inventor: Colin Robert Dunbar.*)

The invention relates to blown discharge gap switches for use with pulse modulator circuits and the

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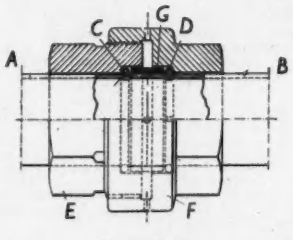
like. The object of the invention is to provide a blown discharge gap switch which overcomes excessive electrode and trigger wear and which can be used at higher pulse repetition rates. Referring to the drawing, the cathode is in the form of two metal plates *A* and *B*, each of which has two pole pieces extending towards the centre. The plates are spaced by two distance pieces *C* and *D* to provide two channels for air exits. *E* and *F* are rings of metal, conveniently brass, through which inlets or outlets for air may be made. The cathode plates, distance pieces and metal rings, together with insulating end pieces *G* and *H*, which are of material such as "Perspex," are firmly bolted together so as to form a cylindrical chamber. End piece *G* has a tapped hole in its centre through which is screwed a trigger electrode *J*. The trigger electrode is a metal tube through which air can be blown, and it carries a cup *K*, also of material such as "Perspex," which serves to deflect air coming through holes *L* into the gap between trigger and cathode. End piece *H* is also tapped and into it is screwed an anode *N* so that it faces the trigger and is situated on the same axis. The anode may be either a metal rod or tube with a rounded end, but the most satisfactory form is that shown in the drawing, where a tube having a solid metal end piece is employed. The method of operation of the switch is that when a trigger voltage pulse is applied between the trigger and anode electrodes breakdown occurs and is followed by the breaking down of the gap between anode and cathode; the discharge passing from anode to trigger and then from trigger to cathode. The actual mechanism of the main anode to cathode breakdown is uncertain but it may be that: (*a*) the trigger pulse ionises the air in the main gap; or (*b*) the ultra-violet light generated by the trigger-anode breakdown causes photo-emission at the cathode. The excessive wear of trigger electrodes experienced in previous designs of blown discharge gap switch caused by the main discharge passing from anode to cathode via the trigger electrode, is reduced in the present invention owing to the large surface area of the tubular trigger electrode. Modified designs with various air path arrangements are also shown in the specification.—*July* 24, 1957.

## TUBE AND PIPE CONNECTIONS

**779,007.** July 21, 1952.—PIPE JOINTS, Edmund Gressel, 154, Schulstrasse, Aadorf, Thurgau, Switzerland.

The invention relates to a process which enables a reliable fluid tight joint to be made between pipes without the use of packing even under high internal pressures. The two pipes to be connected *A* and *B* each has approximately at the end a steel spring ring



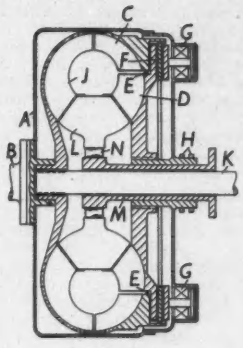

No. 779,007

*C*, *D*, in grooves. The rings are sprung into the grooves after the two nuts *E* and *F* have been pushed on to the pipes. The spring rings are prevented from slipping out of the grooves by the tightening nuts. The opposed end faces of the pipes can be turned or ground smooth to form sealing faces. When the nuts are tightened they push the pipes together with the aid of the spring rings to seat themselves on each other under pressure without the use of any additional sealing means. A sleeve *G* may be disposed over the ends of the pipes and between the rings. Holes in the wall of the tightening nut make it possible, when the pipes are in use, to ascertain whether the connection is fluid-tight.—*July* 17, 1957.

## POWER TRANSMISSION

**780,983.** July 16, 1954.—HYDRAULIC TORQUE CONVERTERS, The Rover Company, Ltd., Meteor Works, Lode Lane, Solihull, Birmingham. (*Inventor: Maurice Fernand Cary Wilks.*)

The invention relates to hydraulic torque converters for road vehicles and comprising a rotary-vaned driving pump, a driven turbine, and an intermediate reaction member. Its object is to provide an improved construction, whereby high efficiency of power transmission can be obtained over a wide range of speed variation. Referring to the drawing, a hollow rotary housing *A* is secured to the driving shaft *B*. The pump consists of two separate and concentric vaned parts *C* and *D*, designed to be equivalent to a single vaned pump of conventional form. The inner part *D* is secured to, or forms an integral part of, the housing. The outer part *C* is supported on the inner part by a ring of bearing balls *E*, and is coupled to the part *D* through a clutch *F*. As shown, the clutch is operated by electromagnets *G*, the windings of which can be supplied with current through slip rings *H* on the housing. In association

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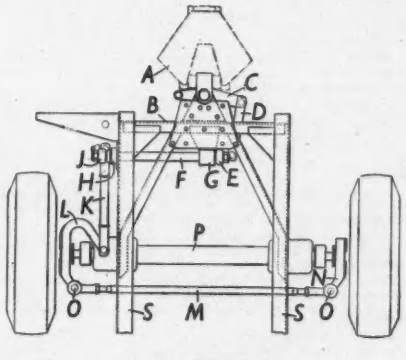
with the pump are arranged in the usual manner the turbine *J*, which is secured to the driven shaft *K*, and the reaction member *L*, which can be coupled to a fixed sleeve *M* by a clutch *N*. The arrangement is such that under heavy load, and when a relatively large difference of speed exists between the driving and driven shafts, the pump parts *C* and *D* are interconnected by the clutch *F*. In this condition the parts operate jointly in the same manner as a single pump. Under light load conditions, and when a relatively small difference of speed exists between the driving and driven shafts, the clutch *F* is released and the part *D* then provides the required pumping action, the part *C* being free to rotate idly under the action of the liquid flowing between its vanes.—*August* 14, 1957.

## ROAD TRANSPORT

**781,304.** September 30, 1954.—TRAILER VEHICLES, Crossley Motors, Ltd., Errwood Park, Stockport. *Inventor: Frederick Ernest Randle.*

The invention has for its object to provide a steering mechanism for low-loading trailer vehicles, and provides for correct action of the trailer front wheels to prevent tyre scrub. As shown in the drawing, the trailer vehicle is attached to the towing vehicle by the drawbar *A* which is pivoted to the front frame member *B* of the trailer to turn about a vertical axis. Attached to the drawbar is a short lever *C* extending to one side at an angle of about 90 deg. to the drawbar. At the end of the lever is pivoted a link *D* leading to an arm *E*, which extends downwards from one end of a steering shaft *F*. This shaft is mounted in bearings *G* and *H* under the trailer floor and extends transversely. It is turned by the arm *E* as the drawbar *A* pivots when the towing vehicle turns a corner. At the other end of the steering shaft *F* near the side of the trailer

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another arm *J* extends down with its lower end slightly ahead of the lower end of the first arm *E*. The arm *J* is attached at its lower end to a link *K* to a steering lever *L* on a wheel mounting, the lever being connected by a track rod *M* to a steering lever *N* for the other wheel. The levers *L* and *N* are connected to the track rod *M* by ball joints *O*. The wheel mountings are pivotally attached to an axle on which the trailer is suspended by springs. The dimensions and design of the drag link, the steering levers and the track rod are such as to give relative angular displacements of the two road wheels to ensure satisfactory cornering. It will be seen that the steering equipment is located entirely below the trailer floor, carried by the front member *B* and the side frame members *S*.—*August* 14, 1957.

## Launches and Trial Trips

CITY OF GUILFORD, cargo ship ; built at Wallsend by Swan, Hunter and Wigham Richardson, Ltd., for the Ellerman Lines, Ltd.; length between perpendiculars 405ft, breadth moulded 59ft, depth moulded to shelter deck 36ft 9in, load draught 24ft 6in, deadweight 7400 tons, service speed 14½ knots ; four holds deep tanks, derrick complement include one 70-ton and 10-ton and 7-ton derricks, electric winches, three 180kW diesel-driven generators; Clark-Sulzer single-acting, two-stroke diesel engine, eight cylinders, 720mm diameter by 1250mm stroke, 5040 b.h.p. at 121 r.p.m. Launch, June 27.

LONDON RESOLUTION, oil tanker ; built by the Furness Shipbuilding Company, Ltd., for London and Overseas Freighters, Ltd.; length between perpendiculars 560ft., breadth moulded 80ft, depth moulded 42ft 3in, deadweight 24,800 tons on 32ft 4in summer draught ; designed trial speed 14½ knots ; twenty-seven cargo oil tanks, one main cargo pump room, three 1000 tons per hour turbine-driven cargo oil pumps, three 150 tons per hour vertical duplex stripping pumps, steam cargo winches ; two 325kW turbine-driven generators, one 100kW diesel-driven generator ; one set of Richardsons Westgarth double reduction geared turbines, 7300 s.h.p. at 100 propeller r.p.m., two Foster-Wheeler "D" water-tube boilers supply steam at 450 lb per square inch and 750 deg. Fah. Launch, June 27.

MOUNT EDEN, trawler ; built by John Lewis and Sons, Ltd., for North Eastern Fisheries, Ltd.; length between perpendiculars 120ft, breadth 25ft, depth 12ft 6in ; fish room 7000 cubic feet, electric trawl winch, capacity 1000 fathoms of 2¾in warp ; Mirrlees K.S.S.6 diesel engine, 712 b.h.p. at 220 r.p.m. Trial, June 27.

EASTGATE, oil tanker ; built by Joseph L. Thompson and Sons, Ltd., for the Turnbull Scott Shipping Company, Ltd.; length between perpendiculars 530ft, breadth moulded 69ft 3in, depth moulded 39ft, deadweight 18,000 tons on 29ft 6in draught ; thirty-three cargo oil tanks ; one set of Wallsend Slipway double reduction geared turbines, 7500 s.h.p. at 100 propeller r.p.m., service speed 14½ knots. Launch, June 29.

PURMEREND, oil tanker ; built by the Netherlands Dock and Shipbuilding Company, Ltd., for N.V. Amsterdamse Maritiem Transport Maatschappij ; length between perpendiculars 530ft, breadth 69ft 3in, depth 39ft, deadweight 18,000 tons ; thirty-three cargo oil tanks ; one set of Werkspoor geared turbines, 8300 s.h.p. Launch, June 29.

## Catalogues and Brochures

G. AND J. WEIR, Ltd., Cathcart, Glasgow, S.4.—Leaflet illustrating and describing "Thermoflex" heating elements for sea water evaporators.

LANCASHIRE DYNAMO AND CRYPTO, Ltd., Trafford Park, Manchester, 17.—Illustrated catalogue describing geared motor units, 1 h.p. to 60 h.p.

DESOUTTER BROTHERS, Ltd., The Hyde, Hendon, London-N.W.9.—Loose-leaf catalogue describing and illustrating light-weight pneumatic tools.

PEGSON, Ltd., Coalville, Leicestershire.—Leaflet giving general information about heavy-duty four-bearing screens and "Live Wire" vibrating screens.

BRITISH WOOD PRESERVING ASSOCIATION, 6 Southampton Place, London, W.C.1.—Leaflet No. 9, entitled "Wood Preservatives of the Organic Solvent Type."

D. ROBINSON AND CO., 58, Oaks Avenue, Worcester Park, Surrey.—Illustrated catalogue giving technical details of the range of relays manufactured by the company.

SIMPLIFIX COUPLINGS, Ltd., 157, Victoria Street, London, S.W.1.—Catalogue illustrating and describing some present-day applications of "Simplifix" compression joints.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., General Chemicals Division, Millbank, London, S.W.1.—Booklet dealing with metal degreasing by the Trichloroethylene process.

BRITISH BITUMEN EMULSIONS, Ltd., Dundee Road, Trading Estate, Slough, Bucks.—Pamphlet giving details of "Kyljack" accelerator and hardener for concrete and mortar mixes.

COURTBURN POSITIONERS, Ltd., Bedford.—Loose leaf folder containing details of work handling equipment for welding operations, including rotators, positioners, operators' platforms, clamps and vices.

VOKES, Ltd., Henley Park, Guildford, Surrey.—Pamphlet on the tests made by this company to determine the most suitable kind of air filter for electric and diesel-electric railway locomotive use in industrial areas.

OZALID COMPANY, Ltd., 62, London Wall, London, E.C.2.—Illustrated leaflet describing the "Ozamajor" combined table top exposing and dry developing unit, capable of reproducing drawings up to 45in in width.

CHANCERY INSULATIONS, Ltd., 93–94, Chancery Lane, London, W.C.2.—Leaflet describing the "Seel" incombustible roof lining. The lining is applied by spraying and consists of asbestos fibres which are bonded to the sheeting, eliminating any air space.

ENGINEERING DIAMONDS, Ltd., 26, Warwick Row, Coventry.—Leaflet dealing with a precision dressing slide unit, model PDS.29. It is said to be applicable to almost any kind of grinding machine for the purpose of dressing angular faces.

PETER LIND AND CO., Ltd., Romney House, Tufton Street, Westminster, London, S.W.1.—Illustrated book entitled "Concrete Achievements," issued to commemorate the fortieth anniversary of the company. The book is a pictorial survey of work completed.

BRITISH IRON AND STEEL RESEARCH ASSOCIATION, 11, Park Lane, London, W.1.—Booklet entitled "Computers and Steel," by D. G. Owen. This booklet is designed to explain the operation of electronic computers, and some of the ways in which they can be of use to the steel industry.

THE FEDERATION OF CIVIL ENGINEERING CONTRACTORS, Romney House, Tufton Street, Westminster, London, S.W.1.—Leaflet entitled "Training Schemes in the Civil Engineering Industry." Details are given about the practical training of young engineers and the training of contractors' plant mechanics.

W. J. MEDDINGS, Ltd., 16, Berkeley Street, London, W.1.—Illustrated catalogue giving technical details of "Pacera Maxam" air hydraulic feed unit. Designed to operate from normal factory airline pressures, it is intended mainly for the conversion of drilling machines from manual to power operation.

HELLEFORS BRUKS AKTIEBOLAG, Hellefors, Sweden (Ernst B. Westman, Ltd., 39, Lombard Street, London, E.C.3).—Booklet giving details of "Remko" magnetic iron. It is described as an exceptionally soft, pure iron of uniform composition and properties, characterised by very low coercive force and high induction. It is claimed to be especially suitable for the manufacture of frames, yokes, armatures and cores in telephone relays.

THE LARMAR ENGINEERING COMPANY, Ltd., Margaretting, Ingatestone, Essex.—Leaflet giving details about the "Larmar" turret speeder. This fitting is designed for speeding up the movement of the capstan turret ; it is fitted to one of the arms of the star wheel, and at a short radius from the centre of the hub to make operation easier. It is supplied ready for fitting to Ward, Herbert and other makes of capstans, turret lathes, and various machine tools.

THE GENERAL ELECTRIC COMPANY, Ltd., Component Sales Department, Osram Lamp Works, East Lane, Wembley, Middlesex.—Illustrated brochure describing some of the metallic materials and their uses, manufactured by the company. The booklet has sections dealing with tungsten, molybdenum, molybdenum-tungsten alloys, other metals and alloys supplied as wire, lead wires, filament coils and filament supports, diamond powder and diamond dies, and heavy alloys.

BRITISH GEON, Ltd., Devonshire House, Piccadilly, London, W.1.—Technical booklet No. H.I., describing the "Hycar" series of oil-resisting synthetic rubbers. Summary Sheet No. 3 of "Hycar" nitrile rubbers and lattices. Booklet No. G.5, entitled "Geon Vinyl Compounds," describes the range of compounds made from Geon vinyl resins. Details are also given of the properties, use and processing of the compounds ; included also are recommended process conditions for extruding and for injection moulding, and special reference is made of compounds specifically formulated to meet electrical specifications.

## Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

*Mon., Sept.* 2.—SHEFFIELD BRANCH : Royal Victoria Station Hotel, Sheffield, Chairman's Address, 7.15 p.m. ★N.E. LONDON BRANCH : Angel Hotel, Ilford, "Any Questions ?" 8 p.m.

*Tues., Sept.* 3.—S.E. LONDON BRANCH : Eltham Congregational Church Hall, Court Road, London, S.E.9, "Instrumentation of Industrial Boiler Plant," L. F. Cohen, 7.15 p.m. ★W. LONDON BRANCH : Windsor Castle Hotel, Hammersmith, London, W.6, "Safety Precautions on Building Sites," J. A. Haywood, 7.30 p.m.

*Wed., Sept.* 4.—GLASGOW BRANCH : Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.3, "The Cathode-Ray Tube," Film, 8 p.m. ★MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, "The Modern Diesel Engine," T. E. Draper, 7 p.m. ★N. LONDON BRANCH : Queen's Head, 677, Green Lanes, Harringay, London, N.4, "Earth Leakage Equipment," J. Robbins, 7.45 p.m. ★PRESTON BRANCH : R.A.F.A. Club, East View, Preston, "Fire-Fighting and Accidents in the Home," O. C. Budd, 7.30 p.m.

*Thurs., Sept.* 5.—SOUTHAMPTON BRANCH : Polygon Hotel, Southampton, "Electrical Accidents and Factory Regulations," S. J. Emerson, 8 p.m.

*Fri., Sept.* 6.—LIVERPOOL BRANCH : Liverpool Engineering Society, 9, The Temple, 24, Dale Street, Liverpool, Chairman's Address, A. Robertson, 6.30 p.m.

### ENGINEERING, MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION

*To-day to Thurs., Aug.* 30 *to Sept.* 12.—Olympia, Hammersmith Road, London, W.14, open daily 10 a.m. to 6 p.m., Fridays 10 a.m. to 8 p.m.

### ENGINEERS' GUILD

*Fri., Sept.* 20.—S. WALES AND MONMOUTHSHIRE BRANCH : Old Arcade Inn, Church Street, Cardiff, Luncheon, 12.45 p.m.

*Thurs., Sept.* 26.—METROPOLITAN BRANCH : Caxton Hall, Caxton Street, Westminster, London, S.W.1, Annual General Meeting, Discussion on "The Aims and Future Policy of the Guild," 6 p.m.

### INCORPORATED PLANT ENGINEERS

*Tues., Sept.* 3.—LONDON BRANCH : Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2, "Maximum Demand and Power Factor and their Effect on the Electricity Tariff," T. A. Williams, 7 p.m. ★EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, Members' Evening, 7 p.m.

*Wed., Sept.* 4.—LEICESTER BRANCH : Bell Hotel, Leicester, "The Painting of Buildings," R. Woodwards, 7 p.m.

*Mon., Sept.* 9.—DUNDEE BRANCH : Mathers Hotel, Dundee, "Variable-Speed Drives with Voltage Regulation Equipment," 7.30 p.m. ★MERSEYSIDE AND N. WALES BRANCH : The Blossoms, City Road, Chester, "The Cost Accountant and the Plant Engineer," R. G. Hall and B. J. Willson, 7.15 p.m.

*Tues., Sept.* 10.—MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, Chairman's "At Home," 7.15 p.m.

*Wed., Sept.* 11.—W. BRANCH : Grand Hotel, Bristol, "Fire Prevention in Industrial Buildings," 7.15 p.m.

*Thurs., Sept.* 12.—GLASGOW BRANCH : Scottish Building Centre, Glasgow, "The Design and Application of Rotary and Reciprocating Air Compressors," W. Scott, 7.15 p.m. ★N.E. BRANCH : Roadway House, Oxford Street, Newcastle upon Tyne, "Internal Combustion Engines as Applicable to Plant Engineering," Norman Parry, 7 p.m.

*Tues., Sept.* 17.—BIRMINGHAM BRANCH : Hotel Leofric, Coventry, "Titanium as a Material of Construction in the Chemical Industry," K. W. J. Bowen, 7.30 p.m.

*Wed., Sept.* 18.—KENT BRANCH : King's Head Hotel, High Street, Rochester, Ladies' Film Evening, 7 p.m.

*Thurs., Sept.* 19.—BLACKBURN BRANCH : Golden Lion Hotel, Blackburn, Joint Meeting with Institute of Fuel, "Fuel and Power Position in the United Kingdom," Rear-Admiral Sir Sidney Frew, 7.30 p.m.

*Tues., Sept.* 24.—GLASGOW BRANCH : Scottish Building Centre, 425–427, Sauchiehall Street, Glasgow, Joint Meeting with the Institution of Heating and Ventilating Engineers, "Steam," and "Combustion and the Chain Grate Stoker," 7.15 p.m.

★S. WALES BRANCH : South Wales Engineers' Institute, Park Place, Cardiff, "Metal Degreasing by Trichloroethylene," and "Metal Pretreatment in Industry," 7.15 p.m.

*Thurs., Sept.* 26.—SHEFFIELD AND DISTRICT BRANCH : Grand Hotel, Sheffield, "The Design of Rolling Mills, with particular reference to Hot and Cold Ferrous Mills." M. Langen, 7.30 p.m.

*Fri., Sept.* 27.—BIRMINGHAM BRANCH : Imperial Hotel, Temple Street, Birmingham, "Some Principles of Radiant Heating," P. A. Coles, 7.30 p.m.

*Mon., Sept.* 30.—W. AND E. YORKSHIRE BRANCH : Leeds University, "The Safe Use of Electricity," J. J. Emerson, 7.30 p.m.

*Tues., Oct.* 1.—E. MIDLANDS BRANCH : County Hotel, Theatre Square, Nottingham, "The Heat Pump : Some Aspects of its Application," J. A. Sumner, 7 p.m. ★EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, "Practical Plant Engineering in the Chemical Industry," C. W. Winstock, 7 p.m. ★PETERBOROUGH BRANCH : White Lion Hotel, Church Street, Peterborough, "Hydro-Electric Power Development," G. C. Cummings, 7.30 p.m.

*Wed., Oct.* 2.—LEICESTER BRANCH : Bell Hotel, Leicester, "Factory Flooring," F. C. Harper; 7 p.m. ★SOUTHERN BRANCH : Royal Beach Hotel, Portsmouth, "The Engineer and the Clean Air Act," E. C. Rogers, 7.30 p.m.

*Tues., Oct.* 8.—MANCHESTER BRANCH : Engineers' Club, Albert Square, Manchester, "Chain Grate Stokers," C. H. G. Hayward, 7.15 p.m.

*Thurs., Oct.* 10.—GLASGOW BRANCH : Scottish Building Centre, 425–427, Sauchiehall Street, Glasgow, "The Measurement and Prevention of Smoke from Industrial Boilers," T. F. Hurley, 7.15 p.m. ★MANCHESTER BRANCH AND MERSEYSIDE AND N. WALES BRANCH : Joint Meeting, Aboard Clubship "Landfall," "What Purpose does Incorporated Plant Engineers Serve ?" 7.15 p.m. ★N.E. BRANCH : Roadway House, Oxford Street, Newcastle upon Tyne, "The Manufacture of Tubes," H. B. Elliot, 7 p.m.

### INSTITUTE OF FUEL

*Wed., Oct.* 9.—Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, Symposium on "Flames and Industry," 10 a.m.

### INSTITUTE OF METALS

*Mon. to Fri., Sept.* 16 *to* 20.—Forty-ninth Annual Autumn Meeting, 1957, to be held in Glasgow.

### INSTITUTE OF THE MOTOR INDUSTRY

*To-day and Sat., Aug.* 30 *and* 31.—St. Catharine's College, Cambridge, Eleventh Annual Summer School.

### INSTITUTE OF PETROLEUM

*Wed., Sept.* 4.—26, Portland Place, London, W.1, "Some Developments in Marine Drilling Foundations," A. Kranendonk, 5.30 p.m.

### INSTITUTE OF PHYSICS

*Tues. to Thurs., Sept.* 10 *to* 12.—ELECTRON MICROSCOPY GROUP : University College of North Wales, Bangor, Annual Conference.

### INSTITUTION OF ENGINEERING DESIGNERS

*Mon., Sept.* 9.—N.E. BRANCH : Northern Architectural Association Hall, 6, Higham Place, Newcastle upon Tyne, Chairman's Address, Informal Discussion on Branch Affairs, 7.15 p.m.

*Mon., Oct.* 14.—N.E. BRANCH : Northern Architectural Association Hall, 6, Higham Place, Newcastle upon Tyne, "Building Structures," G. Gladstone, 7.15 p.m.

### INSTITUTION OF LOCOMOTIVE ENGINEERS

*Wed., Sept.* 25.—GENERAL MEETING : Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1, Presidential Address, E. S. Cox, 5.30 p.m.

### INSTITUTION OF MECHANICAL ENGINEERS

*Sat., Aug.* 31.—S. BRANCH : Whole-day visit to the pumping stations of the Mid-Wessex Water Company, Frimley, Surrey.

*Sat., Sept.* 14.—SOUTHERN BRANCH : Whole-day visit to the Greenham Common Base of the United States Air Force, Newbury, Berks, 10 a.m.

### INSTITUTION OF PRODUCTION ENGINEERS

*Wed., Sept.* 4.—COVENTRY GRADUATE SECTION : Visit to British Piston Ring Company, "Changing from Batch to Flow Production," H. C. Blackford, 7.15 p.m.

*Wed., Sept.* 18.—BIRMINGHAM SECTION : College of Technology, Gosta Green, Birmingham, 4, Film Evening, 7 p.m. ★WOLVERHAMPTON GRADUATE SECTION : Wolverhampton and Staffs College of Technology, Wulfruna Street, Wolverhampton, "Nimonic Preatwork," J. A. Grainger, 7.30 p.m.

*Tues., Sept.* 24.—OXFORD SECTION : Town Hall, Oxford, "Transfer Pressing," 7.30 p.m.

*Wed., Sept.* 25.—SHREWSBURY SECTION : Shrewsbury Technical College, Shrewsbury, "British Clock and Watch Production," R. Lenoir, 7.30 p.m.

*Thurs., Sept.* 26.—NORWICH SECTION : Norwich City College, Ipswich Road, Norwich, "S.G. Iron—A Versatile Engineering Metal," W. W. Braidwood, 7 p.m.

*Fri., Sept.* 27.—LEICESTER SECTION : Grand Hotel, Leicester, "Work Measurement and Its Uses for Management," W. Hewett, 7 p.m.

*Fri., Oct.* 4.—Dorchester Hotel, Park Lane, London, W.1, Annual Dinner.

### IRON AND STEEL INSTITUTE

*Wed. and Thurs., Sept.* 25 *and* 26.—IRON AND STEEL ENGINEERS' GROUP : Church House, Westminster, London, S.W.1, "Air Pollution in the Iron and Steel Industry."

*Tues., Sept.* 24.—4, Grosvenor Gardens, London, S.W.1, Autumn General Meeting, 10.45 a.m., to be followed by a Lecture at the Royal Institution, Albemarle Street, London, W.1, "The Future Engineering Development of the Gas-Cooled Nuclear Reactor," J. M. Kay, 6 p.m.

### MANCHESTER GEOLOGICAL AND MINING SOCIETY

*Thurs., Oct.* 10.—Mining and Technical College, Wigan, Annual General Meeting, 3.30 p.m.

### ROYAL AERONAUTICAL SOCIETY

*Fri., Sept.* 13.—FORTY-FIFTH WILBUR WRIGHT MEMORIAL LECTURE : Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, "Advanced Education and Academic Research in Aeronautics," Clark B. Millikan, 6 p.m.

### SOCIETY FOR WATER TREATMENT AND EXAMINATION

*Wed. to Fri., Oct.* 2 *to* 4.—Palace Hotel, Southend-on-Sea, Autumn Meeting.

## Advanced Engineering Courses

The Application of Work Study. INSTITUTE FOR ENGINEERING PRODUCTION, University of Birmingham, 16, Norfolk Road, Birmingham, 15. A residential executive course for a period of two weeks, commencing on September 2 until September 13. Fee £50.